

**MRT**  
MOBILE RADIO TECHNOLOGY®

Technical information for private, trunked and public safety networks.

NOVEMBER 1989

# 13th Annual Installation and Maintenance Issue



# Vertex--For Business, Industry, and Public Safety.

Vertex Radio Communications, the land mobile division of Yaesu, has been at the forefront of high-tech engineering and quality manufacturing for over 40 years. Always keeping customer satisfaction as their goal, the Vertex line meets the ever-growing demands of private sector, public safety, and governmental organizations.

The Vertex full line of wireless radio equipment is compatible with commercial specifications worldwide, and includes a wide variety of portable, compact/mobile base stations, HF/SSB transceivers,

repeaters, and trunking systems.

Incorporating constant customer feedback with break-through design in synthesized radio communication technology has resulted in innovative products like the FTH-2070 32 Channel 5W Dual Band VHF/UHF Portable radio introduced in 1988. This unequalled radio gained immediate acceptance for its ability to link public safety organizations in time of crisis, and remains unique to Vertex today.

Now, with its expanded line--including the ultra-compact VX-10, 40 and 102 Channel

VHF/UHF Portables -- Vertex Radio Communications provides solutions to communication needs for business, industry, and public safety.

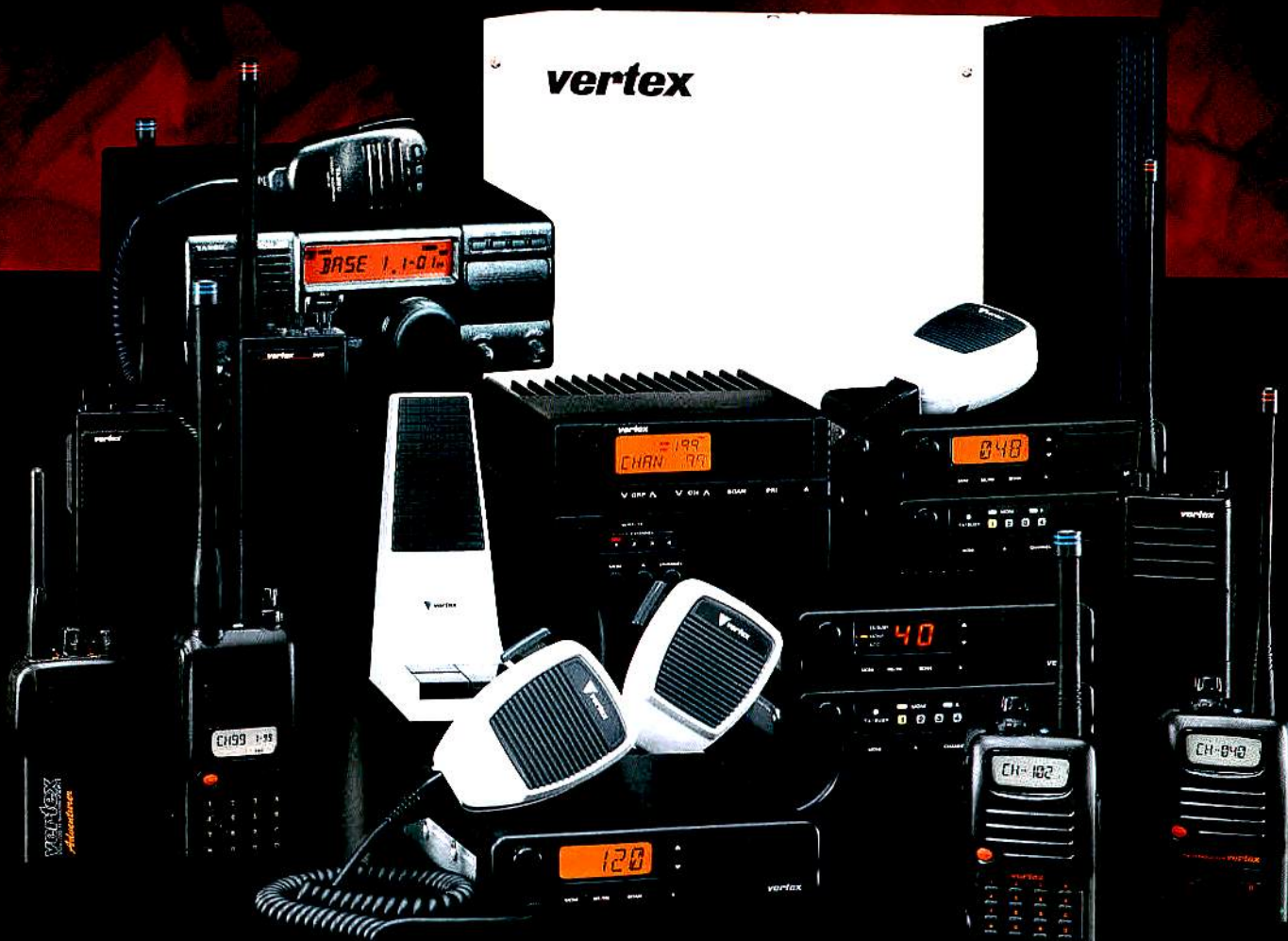
For more information about the complete line of Vertex Radio Communications products, see your authorized Vertex dealer, or call:

**562-404-2700**



**vertex**

RADIO COMMUNICATIONS  
Land Mobile Division of Yaesu U.S.A.



**United States & Canada: Yaesu U.S.A., (562)404-2700**

©1998 Yaesu USA. Specifications subject to change without notice

Circle (1) on Fast Fact Card





# Just the Best

## Simulcast

Self-calibrating  
Network management  
Programmable revert options  
WindowsNT® platform

## Network Switches

Multiple switch systems  
Multiple channel switches  
Single-site operations  
WindowsNT platform

## System Management

Emergency access  
System access priority  
Wide-area roaming  
WindowsNT platform

## Portables

SMARTNET™/SmartZone™  
APCO 16  
APCO 25  
Mil Spec

## Mobiles

SMARTNET/SmartZone  
APCO 16  
APCO 25  
Mil Spec

## Repeaters

Digital  
Analog  
Compact modular design  
175/75W RF output levels



 **EFJohnson®**  
*Your Supplier of Choice*

The viking head EFJohnson logo is a registered trademark of Transcrypt International, Inc.  
WindowsNT is a registered trademark of Microsoft Corporation.  
SMARTNET and SmartZone are trademarks of Motorola, Inc.  
© 1999 Transcrypt International, Inc.

299 Johnson Ave., Waseca, Minnesota 56093

1-800-328-3911 • 507-835-6222 • Fax 507-835-8356 • [www.efjohnson.com](http://www.efjohnson.com)

Circle (4) on Fast Fact Card



# MRT™

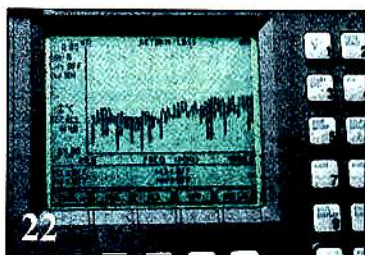
MOBILE RADIO TECHNOLOGY®

November 1999

## 13th Anniversary installation and maintenance issue

**On the cover:** Previously owned analytical instruments offer small shops an affordable path to upgrades. See the cover story on page 20. Cover design by Scott Dolash, art director. Photographs courtesy of RF Imaging and Communications.

### FEATURES



22

#### 20 Exploring experienced equipment *Matthew Halverson*

For small benchtop operations, a 'pre-driven' piece of test equipment may be financially attractive.

#### 22 A walk in the park *Yuenie Lau*

New hand-held analyzers make field testing easier and more convenient with their decreased size and combination of functions.



26

#### 26 Trapping transients: Line surge protection *Alex Gorosito*

Data communications lines and equipment are vulnerable to electrical transients. Assessment of the application guides proper surge protection.



34

#### 34 Do you cut your coax? *Patrick Buller*

A standard approach to installing coaxial cable for mobiles will improve RF power measurements and improve reception quality in fleet vehicles.

### DEPARTMENTS

#### 4 Editorial

*Don Bishop*  
Scanning...

#### 8 Calendar

Editorial index

#### 10 Editorial forum

*Ramona Isbell*  
On the threshold

#### 12 Letters: Schools and communications

#### 16 In the public interest

*Robert H. Schwaninger Jr.*  
Mexican standoff

#### 36 Technically Speaking

The versatile SINAD meter

#### 39 News

Ericsson PRS offers new radio products with digital modulation

#### 43 Product focus: Benchtop equipment

#### 44 Products

Readers' choice: Young Design

#### 48 People

#### 49 Classified

#### 60 Ad index

Vol. 17, Issue 11. Mobile Radio Technology (ISSN 0745-7626) is published monthly by Intertec Publishing, 9800 Metcalf Ave., Overland Park, KS 66212-2215, and is mailed for free to qualified subscribers within the United States and Canada. Periodicals postage paid at Shawnee Mission, KS, and additional mailing offices. Canada Post Publications Mail (Canadian Distribution) Sales Agreement No. 0956309.

POSTMASTER: Send address changes to Mobile Radio Technology, P.O. Box 12960, Overland Park, KS 66282-2960.

SUBSCRIPTIONS: Non-qualified subscribers may subscribe at the following rates: United States and Canada: one-year: \$35. Qualified and non-qualified subscribers in all other countries; one-year: \$45 (surface mail); \$105 (air mail). Subscription information: P.O. Box 12960, Overland Park, KS, 66282-2960.



# NEW from TX RX

## UHF Broadband Collinear Antennas

*With two patents granted for this design, our omnidirectional collinear array antennas add a new dimension to conventional base station antenna coverage. The true corporate-feed design improves pattern control, allowing higher gain from a shorter antenna.*

Model Number	Gain	Freq. Range	Bandwidth	Vertical Beamwidth	Power Handling	Connector
101-68-10-X-01N	10 dBd $\pm 0.5$ dB	450-512 MHz	62 MHz	10°	1000 watts	N female
101-68-10-X-01	10 dBd $\pm 0.5$ dB	450-512 MHz	62 MHz	10°	1000 watts	7/16 DIN

"X" = downtilt = 0, 3, 6 (degrees)

**ONE MODEL COVERS ENTIRE  
450-512 MHz BAND!**

TX RX Systems Inc.  
8625 Industrial Pkwy.  
Angola, NY 14006  
Ph: 716-549-4700  
Fax: 716-549-4772  
Email: sales@txrx.com  
Web Site: www.txrx.com



A member of Bird Technologies Group

Tx & Rx Multicouplers • Tower Mounted Preamplifiers • Signal Boosters • Duplexers • Cavity Filters • RF System Products

Circle (5) on Fast Fact Card



## Scanning . . .

### The little company that grew

Time was when Nextel Communications wanted to convert specialized mobile radio (SMR) spectrum to wireless telephone service.

Many small business operators saw SMR spectrum as theirs to use to serve two-way radio dispatch customers, including those customers that wanted limited telephone interconnect. Nextel found a way to obtain such a large number of licenses throughout the country that many SMR operators were blocked from expanding their channel assignments. There were plenty of SMR operators willing to sell their systems to the company when it was paying lots of dollars—maybe top dollar.

The company then found a way to buy at auction much of the remaining SMR spectrum and gained government approval to relocate incumbent SMRs within the band. That process doesn't seem to be moving rapidly, for a variety of reasons.

When Nextel saw an opportunity to buy licenses that had belonged to a defunct SMR, Geotek Communications, the company sought release from an agreement with the government that capped Nextel's acquisition of additional spectrum in certain cities. Whether that will happen isn't certain, but Nextel has been advancing its cause, step by step, with favorable decisions in the matter by the federal government.

The company found another possible way to increase its spectrum holdings when it cut one more deal with the government to allow it to acquire spectrum from NextWave, a PCS operator that defaulted on payment for spectrum won at an FCC auction.

However matters are resolved involving alleged abuse of the FCC licensing process by Nextel, and companies with which it subsequently merged, the company just may get past all of its spectrum woes if it obtains that PCS frequency band. And, in a way, maybe that will help to divert the company's attention from the SMR band. That could be a relief to incumbents faced with relocation problems. The time incumbents spend resolving legal, regulatory and technical matters is time they can't spend selling service to new customers.

And Nextel? It's doing fine, thanks. It's lost enormous sums of money while

its stock has soared. It bought back stock owned by its departing chairman, Dan Akerson, netting him a couple of hundred million dollars for a few years' work that took the stock from \$16 to \$70. Whatever you may think that Nextel's doing wrong, it does right by its executives (and others who bought the stock low and sold high; there *have* been opportunities with Nextel stock to



do the reverse.)

Events are moving so fast for the company that the days of spectrum warehousing at 800MHz could seem only a distant memory (or nightmare) if it weren't for the fact that small SMR operators still face channel expansion problems.

### Kaiser Permanente

"Hello? Kaiser Permanente? May I have an ambulance, please? Pretty please?"

One of the nation's largest health maintenance organizations, Kaiser Permanente, sent identification cards to its members that include language that might require its members to first call

Kaiser's toll-free number to report potential medical emergencies—not 9-1-1. That alarms the Association of Public-Safety Communications Officials, International (APCO) and the National Emergency Number Association (NENA), among others. They see it as an attempt to divert emergency calls from the 9-1-1 system to manage health care costs.

There are huge flaws with this national toll-free call center idea. The system might have caller ID, that may or may not work, but it won't have the details that 9-1-1 databases provide. The national call center would have tremendous difficulty rerouting the call to the appropriate agency. Some callers might only be able to place one call before circumstances or a decline in their vital signs prevent additional dialing. The possibly more useful follow-up call to 9-1-1 might never happen.

Will Kaiser Permanente clear up the confusion by mailing millions of replacement insurance cards that do not recommend its call center in lieu of 9-1-1? Oh, that costs money.

A second opinion: "Society has all but destroyed the 9-1-1 system. It is now a speed-dial to the cops. People call and ask for the correct time or road conditions," according to a Denver police captain quoted in the September 1999 issue of *Dispatch Monthly* magazine. The story explained how 9-1-1 calls were delayed in that city on July 4 because of calls to report noisy fireworks.

We haven't tried Kaiser Permanente, but even so, we're inclined to prefer 9-1-1, even on the Fourth of July.

*Don Bishop*

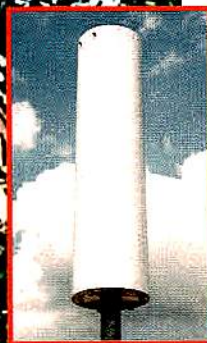
don\_bishop@intertec.com





# **SITE SAVER™**

## Mounting Solutions Get Great Reception From Everyone



### **Introducing DAPA Site Saver Mounting Solutions**

Zoning boards, concerned citizens, wireless users and providers all agree that Site Saver mounting solutions from DAPA are a welcome alternative. Compact and unobtrusive, the Site Saver solution mounts three DAPA antennas on a single pipe. They save space, provide outstanding coverage and can handle high call capacity without compromising the area's aesthetics.

### **Easy On Your Eyes And Your Budget**

Not only are Site Saver solutions the most attractive choice, their low-cost, flexible design makes them ideal for virtually every application and environment. Site Saver mountings work with most DAPA panel antennas, including vertically polarized, or dual (slant 45) antennas. They can be customized for your site with mechanical downtilt, stacking, gap fillers, cylindrical or square radomes.

### **Depend On DAPA To Keep People Communicating**

DAPA celebrates 30 years as a worldwide leader in the design, manufacture and installation of antenna and tower systems. For more information on the Site Saver mounting solutions or other DAPA products, contact us today, and get a great reception without attracting attention.

# **DAPA**

**DAPA Communications, Inc.**

Allegany, NY USA

1-800-325-3272

Int'l +1-716-373-7228

Circle (6) on Fast Fact Card

[www.dapacom.com](http://www.dapacom.com)





### 2000 BUYERS' GUIDE

**PLUS:** Robert H. Schwaninger Jr.'s "In the Public Interest"; editorial commentary from Don Bishop.

### AND IN THE MONTHS TO COME:

Digital signal processing; public safety; industrial telecom; what's new in headsets; towers; coaxial connectors; SCADA; portable batteries; VHF highband.

Visit us  
on the web at  
[www.mrtmag.com](http://www.mrtmag.com)

Buyers' Guide



#### EDITORIAL

Don Bishop, *Editorial Director*  
Ramona Isbell, *Executive Editor*  
David Keckler, *Features Editor*  
Nikki Chandler, *Senior Associate Editor*  
Harold Kinley, C.E.T., *Contributing Editor*  
Donald E. Koehler, *Contributing Editor*

#### EDITORIAL ADVISORY BOARD

John Abbey, *The Abbey Group*  
Alan Burton, founder, *Dispatch Monthly magazine*  
Gene A. Buzzi, *Omnicom Telecommunications Engineering*  
Jack Daniel, *The Jack Daniel Company*  
Gary David Gray, P.E., *Orange County Communications*  
Frederick G. Griffin, P.E., *Frederick G. Griffin P.C.*  
Jim Hendershot, *Radio Design Group*  
Samuel J. Klein, *Cellular Design*  
S.R. McConoughey, P.E., *Mobile Communications Consulting*  
Art McDole, *Salinas, CA*  
Tony Sabino, *Regional Communications*  
Herb Sachs, *Herb Sachs Consulting*  
Robert C. Shapiro, P.E., *Strategic Telecommunications*  
Leon Spencer, *Exxon Computing Services Services*  
Gregory M. Stone, Ph.D., *Quantum Radionics*  
Raymond C. Trott, P.E., *Trott Communications Group*  
William A. Wickline, P.E., *Mentor, OH*

#### REGULATORY CONSULTANT

Robert H. Schwaninger Jr., *Schwaninger & Associates, Washington, DC*

#### DESIGN

Scott Dolash, *Art Director*

#### BUSINESS

Larry Lannon, *Vice President, Communications Division*  
Mercy Contreras, *Group Publisher*  
Patricia Kowalczewski, *Director of Marketing*  
Karen Clark, *Marketing Services Supervisor*  
Melissa Langstaff, *Ad Production Coordinator*  
Nancy Hupp, *Director, Corporate Ad Services*  
Kristi Woods, *Classified Advertising Coordinator*  
Tom Cook, *Director of Editorial Development*  
Doug Coonrod, *Corporate Creative Director*  
Stephanie Hanaway, *Division Director of Marketing*  
Sheri Gronli, *Corporate Circulation Director*  
Julie Neely, *Senior Circulation Manager*  
Customer Service, 800-441-0294 or 913-341-0294  
Raymond E. Maloney, *Chairman*  
Cameron Bishop, *President & CEO*  
Ron Wall, *Chief Operating Officer*  
PRIMEDIA Information Group  
Curtis Thompson, *President*  
PRIMEDIA Inc.  
Tom Rogers, *Chairman and CEO*  
Charles McCurdy, *President*  
Beverly C. Chell, *Vice Chairman*

**CORRESPONDENCE:** Editorial correspondence should be addressed to P.O. Box 12960, Overland Park, KS 66282-2960. tel. 913-341-1300; fax: 913-967-7250; [mrt@intertec.com](mailto:mrt@intertec.com); [www.mrtmag.com](http://www.mrtmag.com).

**MOBILE RADIO TECHNOLOGY** provides technical information to dealers; to private wireless, public safety, public service, community repeater, SMR, ESMR, paging, cellular and PCS system operators; mobile radio equipment manufacturers; manufacturers' representatives, distributors; engineering and consulting firms; national, state and local government and public safety agencies; transportation companies; petroleum and energy products companies; public utilities; and others allied to the field.

**PHOTOCOPY RIGHTS:** Authorization to photocopy items for internal or personal use, or the internal or personal use of specific clients, is granted by PRIMEDIA Intertec, provided that the base fee of US \$2.25 per copy, plus US \$00.00 per page is paid directly to Copyright Clearance Center, 222 Rosewood Dr., Danvers, MA 01923, USA. The fee code for users of the Transaction Reporting Service is 0745-7626/1999 \$2.25 + \$00.00. For those organizations that have been granted a photocopying license by CCC, a separate system of payment has been arranged. Prior to photocopying items for educational use, please contact CCC at 978-750-8400. Organizations or individuals with large quantity photocopy or reprint requirements should contact Jenny Eisele, 913-967-1966 or email: [jenny\\_eisele@intertec.com](mailto:jenny_eisele@intertec.com).

**BACK ISSUES:** Copies of most issues printed within the past two years are available for \$10 per issue; older issues are not. Call customer service at 800-441-0294.

This publication is available in paper or electronic format from Information Express, 3221 Porter Drive, Palo Alto, California 94304-1225. Contact Information Express at 650-494-8787, or visit IE online at [www.express.com](http://www.express.com). This publication is also available via microform and/or electronic databases from Bell & Howell Information and Learning, 300 N. Zeeb Road, P.O. Box 1346, Ann Arbor, MI 48106-1346. Contact UMI at 800-521-0600 (734-761-4700 outside North America) or check UMI's Web site ([www.umi.com](http://www.umi.com)) for additional information on format availability.

#### ADVERTISING SALES OFFICES

##### OVERLAND PARK, KANSAS

Joyce Bollegar, 913-967-1840,  
*East Region (including Eastern Canada)*  
Fax: 913-967-1901  
Email: [joyce\\_bollegar@intertec.com](mailto:joyce_bollegar@intertec.com)  
Dawn Rhoden, *Classifieds*,  
913-967-1861, Fax: 913-967-1735  
Email: [dawn\\_rhoden@intertec.com](mailto:dawn_rhoden@intertec.com)  
Lori Christie, *List Rental Services Representative*,  
913-967-1875, Fax: 913-967-1897  
Email: [lori\\_christie@intertec.com](mailto:lori_christie@intertec.com)  
9800 Metcalf Avenue  
Overland Park, KS 66212-2215

##### SANTA ROSA, CALIFORNIA

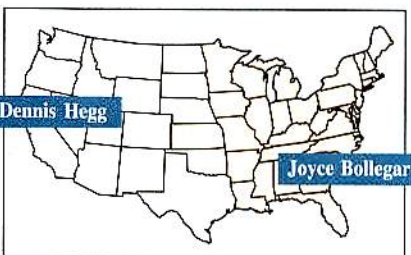
Dennis Hegg, *West region (including Alaska, Hawaii and Western Canada)*  
Phone: 707-541-3763, Fax: 707-541-3721  
Email: [dennis\\_hegg@intertec.com](mailto:dennis_hegg@intertec.com)  
3428 Mendocino Ave.  
Santa Rosa, CA 95403

##### ENGLEWOOD, COLORADO

Mercy Contreras, *Group Publisher*  
Phone: 720-489-3199  
Fax: 720-489-3253  
Email: [mercy\\_contreras@intertec.com](mailto:mercy_contreras@intertec.com)  
5680 Greenwood Plaza Blvd., Suite 100  
Englewood, CO 80111

##### LONDON

Stephen Bell, *International*  
Phone: +44 208 286 8889  
Fax: +44 208 286 8898  
Email: [stephenbell@email.msn.com](mailto:stephenbell@email.msn.com)  
P.O. Box 98  
Worcester Park, Surrey, KT4 8WB  
United Kingdom



Audited circulation.



**INTERTEC PUBLISHING**  
A PRIMEDIA COMPANY

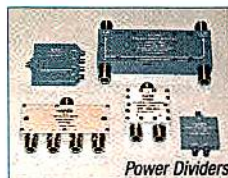
© 1999 by Intertec Publishing Corporation, A PRIMEDIA Company. All rights reserved.



Impossible  
demands,  
absurd deadlines,  
uncompromising  
requirements?  
You've come to  
the right place.

At Narda, we've got the goods to soften hard-nosed customers.

With over 900 high-performance products in 15 microwave categories, we can satisfy any order.



Power Dividers

And with an astonishing 85% of our products in stock, we can ship most of them right away.

If something's out of stock, we'll tell you the exact delivery date. And because Narda's 150,000 sq. ft. manufacturing

facility is the largest in the industry, you'll get it fast.

For over 40 years, we've built Narda's reputation as the premier supplier of the highest quality microwave components.

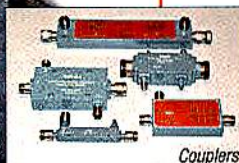
So when it comes to being demanding, we're one tough customer.

Just like yourself.

For more information, call Narda today at 516-231-1700.



Attenuators



Couplers

**narda**  
microwave-east

an **L3** communications company

*It's Narda to be precise.*



© 1999 L-3 Communications, Inc.

Circle (7) on Fast Fact Card



## November

**1-4: Telecommunications Resellers Association Fall Conference and Exposition**, sponsored by TRA, Dallas. Contact: 202-835-9898 or Web site [www.tra.org](http://www.tra.org).

**2-4: Wireless I.T.**, sponsored by the Cellular Telecommunications Industry Association, Santa Clara Convention Center, Silicon Valley, CA. Contact: 202-785-2842 or Web site [www.wow-com.com](http://www.wow-com.com).

**8-9: ENTELEC & UTC Joint Fall Seminar**, JW Marriott, Houston. Contact: 888-503-8700 or email [entelec@pdq.net](mailto:entelec@pdq.net).

**10-14: Communications Marketing Conference**, sponsored by the Communications Marketing Association, Harvey Hotel, Dallas. Contact: Jack Armstrong, 410-308-0808.

**15-16: AMTEX**, sponsored by the American Mobile Telecommunications Association, Hilton, Walt Disney World Village, Lake Buena Vista, FL. Contact: 202-331-7773 or Web site [www.amtausa.org](http://www.amtausa.org).

**15-16: Fourth International Congress on Commercial Trunked Radio**, sponsored by the International Mobile Telecommunications Association, Hilton, Walt Disney World Village, Lake Buena Vista, FL. Contact: 202-331-7773.

**16-17: Advanced RF Safety Training**, sponsored by RF Emission Measurements, Southlake, TX. Contact: 817-312-5363.

**17-19: TelecomLatina**, co-sponsored by *Mobile Radio Technology*, Miami Beach Convention Center, Miami. Contact: 800-288-8606 or Web site [www.telecomlatina.com](http://www.telecomlatina.com).

**19: Radio Club of America Communications Symposium, 91st Anniversary Dinner and Awards Presentation**, New York Athletic Club, New York. Contact: Gerri Hopkins, 732-842-5070.

## 2000

### February

**15-18: APCO Gulf Coast Regional**, sponsored by the Association of Public-Safety Communications Officials—International, Corpus Christi Omni Bayfront, Corpus Christi, TX. Contact: Toni Dunne, 512-305-6918 or Web site [www.apcointl.org](http://www.apcointl.org).

**15-18: N.A.T.E.**, sponsored by the National Association of Tower Erectors, San Diego. Contact: 888-882-5865 or Web site [www.natehome.com](http://www.natehome.com).

**28-March 1: Wireless**, sponsored by the Cellular Telecommunications Industry Association, Ernest Morial Convention Center, New Orleans. Contact: 202-785-0081 or Web site [www.wow-com.com](http://www.wow-com.com).

### March

**6-8: APCO Western States Regional**, sponsored by the Association of Public-Safety Communications Officials—International, Doubletree Hotel Portland, Portland, OR. Contact: RoxAnn Brown, 503-690-4911 ext. 206 or Web site [www.apcointl.org](http://www.apcointl.org).

**19-22: ENTELEC**, sponsored by ENTELEC, Dallas Convention Center, Dallas. Contact: 281-357-8700 or Web site [www.entelec.org](http://www.entelec.org).

**22-24: International Wireless Communications Expo**, co-sponsored by *Mobile Radio Technology*, Las Vegas Convention Center, Las Vegas. Contact: 800-288-8606.

### April

**10-12: APCO North Central Regional**, sponsored by the Association of Public-Safety Communications Officials—International, Holiday Inn, Worthington, OH. Contact: Jay Somerville,

614-761-6530 or Web site [www.apcointl.org](http://www.apcointl.org).

### May

**8-11: Telecommunications Resellers Association Spring Conference and Exposition**, Philadelphia Marriott. Contact: 202-835-9898 or Web site [www.tra.org](http://www.tra.org).

**15-18: Spring Vehicular Technology Conference**, sponsored by IEEE Vehicular Technology Society, Hotel Pacific Tokyo, Tokyo. Contact: 81-468-40-3552 or email [matumoto@mars.yrp.nttdocomo.co.jp](mailto:matumoto@mars.yrp.nttdocomo.co.jp).

**30-June 1: Canadian Wireless**, sponsored by the Canadian Wireless Telecommunications Association, Toronto, Canada. Contact: 613-233-4888, ext. 102, or Web site [www.cwta.ca](http://www.cwta.ca).

### June

**4-8: Supercomm**, sponsored by TIA and USTA, Georgia World Congress Center, Atlanta. Contact: 800-278-7372.

**25-29: UTC Telecom**, sponsored by UTC, The United Telecom Council, Phoenix. Contact: 202-857-1881 or Web site [www.utc.org](http://www.utc.org).

### August

**13-17: Association of Public-Safety Communications Officials—International (APCO) National Conference**, Boston. Contact: 904-322-2500 or Web site [www.apcointl.org](http://www.apcointl.org).

### September

**19-22: Fall Vehicular Technology Conference**, sponsored by IEEE Vehicular Technology Society, Seaport Hotel, Boston. Contact: 904-322-2500

**26-29: Personal Communications Showcase**, sponsored by PCIA, McCormick Place, Chicago. Contact: 703-739-0300 or [www.pcs00.com](http://www.pcs00.com).

# EDITORIAL INDEX

AC/DC Industries	44
Adaptive Broadband	46
Advanced Charger Technology	42
Advanced Photonix	20
Amtronix Instruments	20
Andrew	42
Anritsu	22
AVCOM	43
Bell South Wireless Data	42
Berkeley Varitronics Systems	42
C.E.S. Wireless	40
CapRock Communications	42
Citel America	26, 33
Convex	43
Dataradio	46
David Clark	40
Eaton	42
EDX Engineering	42
EFJohnson	39, 42
Energystat Ambulance Service	42
Ericsson Private Radio Systems	39
Florida Power & Light	39
Freeman Communications	40
Fulton Bag & Cotton Mill	48
Gas Supply	42

GE Harris Railway Electronics	42
Glenayre Technologies	48
Globe Electric	44
Hark Systems	47
Harris	42
Helper Instruments	36
IFR	43
In-Touch Management Systems	48
ITECH	43
Kaiser Permanente	4
Kenwood Communications	42
Kwik-Page Communications	16
Maxon America	40
MCI Worldcom	10
Metawave Communications	48
Motorola	39, 41, 42, 48
Multicom 2-way	41
Multiplier Industries	42
National Communications Group	46
Nextel Communications	4, 40
NextWave	4
Nokia	39
Nortel Networks	42
NTX Comm Supply	41
Omnipoint Communications	42

Orbcomm	42
PanaVise Products	48
Qualcomm	39
Relm Wireless	41, 42
RF Imaging and Communications	20, 21
RFS Cablewave	42
SatCom Systems	42
Schwaninger & Associates	16
Simulcast Solutions	43
SiteSafe	48
SoftWright	42
Spectracom	42
Sprint	10
SSD&W	22
STI-CO Industries	45
Tellabs	48
Texas Instruments	42
The Yankee Group	10
Transcrypt Secure Technologies	39, 42
Uniden	40
Ventronics	45
Vertex/Standard	40
Wireless Facilities	42
Young Design	44
Zetron	40, 47



# Out Here, Field-Proven Takes On A Certain Significance.



You can't always predict where your next job will take you, but there is something you can rely on: your Site Master™ from Anritsu. After years of being dropped, tossed and exposed to some of the harshest weather conditions imaginable, Site Master has proven to be the world's best selling cable and antenna analyzer.

Site Master delivers accurate, repeatable performance. A field replaceable NiMH battery. And a sleek, lightweight design that's not only easy to carry, it's extremely rugged. Site Master's

user-friendly, menu-driven interface is easy to use and requires little or no training. And thanks to its ability to identify, record and solve a multitude of problems without sacrificing measurement accuracy, Site Master makes deployment, performance verification and maintenance a breeze, no matter where you are.

For more information call 1-800-ANRITSU or check out our website at [www.global.anritsu.com](http://www.global.anritsu.com). Site Master from Anritsu. The preferred choice among leading network operators and service providers worldwide.



## Site Master

©1999 Anritsu Company Sales Offices: United States and Canada, 1-800-ANRITSU, Europe 44(01582)433200, Japan 81(03)3446-1111, Asia-Pacific 65-2822400, South America 55(21)527-6922, <http://www.anritsu.com>

# Anritsu

**One world. One name. Anritsu.**





## On the threshold

With the next issue of MRT dedicated to our annual Buyers' Guide—and with the new millennium lurking around the corner—now is the time to gaze into the proverbial crystal ball and play soothsayer!

I'm going to pass, though. Playing the role of prophet in an industry that is evolving as fast as this one is just too daunting of a task. It's more fun to sit back, listen to the promises and forecasts made by industry leaders, experts and pundits, and throw them

out for you to ponder. In other words, I'll play the reporter and you can make your own predictions. Consider these facts as you prophesy about the upcoming century:

❑ What can we learn from the "love match" between industry giants MCI Worldcom and Sprint? Yes, it's news from that "other part" of the wireless market, but any significant advancement made by cellular and PCS ranks affects the efforts of the land mobile industry. The near-\$130 billion price tag seems ridiculous, considering that the entire international wireless industry's gross revenue in 1998 was just approaching \$200 billion. The U.S. cellular/PCS annual revenue alone was around \$39 billion in '98. Is this indeed a "perfect marriage" that will result in a powerful, innovative service-oriented mega-company? Is it a wake-up call to the FCC to preserve healthy competition? Or, is it a forewarning to the consumer of fewer options and higher rates?

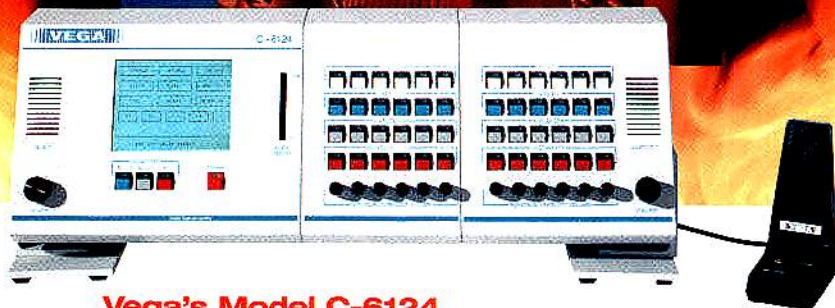
❑ And then there is the promise made by FCC Chairman William Kennard that the commission's new strategic plan, "A New FCC for the 21st Century," will help bring about a new FCC. According to Kennard, the FCC is reinventing itself to keep pace with the "rapidly changing communications industry landscape." He added that by following this plan, the FCC will be able to respond fully and quickly to emerging technologies and increased convergence, as well as "the inexorable movement from regulation to competition." Within five years, the FCC's vision is to restructure the agency into the functional areas of enforcement, consumer information, licensing, competition/policy and international communications. Just think, a new FCC along with the new millennium. What will they think of next?

The issues of spectrum, regulation and efficient technologies have preoccupied us during the '90s. What will we face in the new decade? Email us at [mrt@intertec.com](mailto:mrt@intertec.com) with your opinions, and we'll post them on the Web at [www.mrtmag.com](http://www.mrtmag.com).

—Ramona Isbell

[ramona\\_isbell@intertec.com](mailto:ramona_isbell@intertec.com)

## Are you in Dispatching Hell?



### Vega's Model C-6124

Get out of the heat with Vega's model C-6124, with its cool touch-screen and independent line selection. The C-6124 offers up to 24-line control, instant PTT, and loads of additional features. Any line can be configured as a dedicated 2/4 wire radiocircuit, dial-up access or full duplex conventional PSTN telephone circuit, (simply plug in the appropriate module). Any combination of lines can be set-up in a crosspatch mode. C-6124 with its future expandability will keep you out of the inferno.



8601 East Cornhusker Highway  
Lincoln, Nebraska 68507

Phone: (402) 467-5321  
Toll-Free: 800-752-7560

Fax: (402) 467-3279  
e-mail: [vega\\_signal@earthlink.net](mailto:vega_signal@earthlink.net)  
web: [www.vega-signaling.com](http://www.vega-signaling.com)





MODEL SS-10TK



MODEL SS-12IF



MODEL SS-18



MODEL SS-25M



MODEL SRM-30



MODEL SRM-30M-2



MODEL SS-12SM/GTX



MODEL SS-IDEFJ-98

# ...POWER ON WITH ASTRON

SWITCHING POWER SUPPLIES...

## SPECIAL FEATURES:

- HIGH EFFICIENCY SWITCHING TECHNOLOGY SPECIFICALLY FILTERED FOR USE WITH COMMUNICATIONS EQUIPMENT, FOR ALL FREQUENCIES INCLUDING HF
- HEAVY DUTY DESIGN
- LOW PROFILE, LIGHT WEIGHT PACKAGE
- EMI FILTER
- MEETS FCC CLASS B

## PROTECTION FEATURES:

- CURRENT LIMITING
- OVERVOLTAGE PROTECTION
- FUSE PROTECTION
- OVER TEMPERATURE SHUTDOWN

## SPECIFICATIONS:

INPUT VOLTAGE: 115 VAC 50/60HZ  
OR 220 VAC 50/60HZ  
SWITCH SELECTABLE  
OUTPUT VOLTAGE: 13.8VDC

AVAILABLE WITH THE FOLLOWING APPROVALS: UL, CUL, CE, TUV.

## DESKTOP SWITCHING POWER SUPPLIES

MODEL	CONT. (Amps)	ICS	SIZE (Inches)	Wt.(lbs.)
SS-10	7	10	1 1/2 x 6 x 9	3.2
SS-12	10	12	1 1/2 x 6 x 9	3.4
SS-18	15	18	1 1/2 x 6 x 9	3.6
SS-25	20	25	2 1/4 x 7 x 9 1/2	4.2
SS-30	25	30	3 1/4 x 7 x 9 1/2	5.0

## DESKTOP SWITCHING POWER SUPPLIES WITH VOLT AND AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (Inches)	Wt.(lbs.)
SS-25M*	20	25	2 1/4 x 7 x 9 1/2	4.2
SS-30M*	25	30	3 1/4 x 7 x 9 1/2	5.0

## RACKMOUNT SWITCHING POWER SUPPLIES

MODEL	CONT. (Amps)	ICS	SIZE (Inches)	Wt.(lbs.)
SRM-25	20	25	3 1/2 x 19 x 9 1/2	6.5
SRM-30	25	30	3 1/2 x 19 x 9 1/2	7.0

## WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (Inches)	Wt.(lbs.)
SRM-25	20	25	3 1/2 x 19 x 9 1/2	6.5
SRM-30	25	30	3 1/2 x 19 x 9 1/2	7.0

## 2 ea SWITCHING POWER SUPPLIES ON ONE RACK PANEL

MODEL	CONT. (Amps)	ICS	SIZE (Inches)	Wt.(lbs.)
SRM-25A-2	20	25	3 1/2 x 19 x 9 1/2	10.5
SRM-30A-2	25	30	3 1/2 x 19 x 9 1/2	11.0

## WITH SEPARATE VOLT & AMP METERS

MODEL	CONT. (Amps)	ICS	SIZE (Inches)	Wt.(lbs.)
SRM-25M-2	20	25	3 1/2 x 19 x 9 1/2	10.5
SRM-30M-2	25	30	3 1/2 x 19 x 9 1/2	11.0

## CUSTOM POWER SUPPLIES FOR RADIOS BELOW

EF JOHNSON AVENGER GX-MC41  
EF JOHNSON AVENGER GX-MC42  
EF JOHNSON GT-ML81  
EF JOHNSON GT-ML83  
EF JOHNSON 9800 SERIES  
GE MARC SERIES  
GE MONOGRAM SERIES & MAXON SM-4000 SERIES  
ICOM IC-F11020 & IC-F2020  
KENWOOD TK760, 762, 840, 860, 940, 941  
KENWOOD TK760H, 762H  
MOTOROLA LOW POWER SM50, SM120, & GTX  
MOTOROLA HIGH POWER SM50, SM120, & GTX  
MOTOROLA RADIUS & GM 300  
MOTOROLA RADIUS & GM 300  
MOTOROLA RADIUS & GM 300  
UNIDEN SMH1525, SMU4525  
VERTEX — FTL-1011, FT-1011, FT-2011, FT-7011

## NEW SWITCHING MODELS

SS-10GX, SS-12GX  
SS-18GX  
SS-12EFJ  
SS-18EFJ  
SS-10-EFJ-98, SS-12-EFJ-98, SS-18-EFJ-98  
SS-12MC  
SS-10MG, SS-12MG  
SS-101F, SS-121F  
SS-10TK  
SS-12TK OR SS-18TK  
SS-10SM/GTX  
SS-10SM/GTX, SS-12SM/GTX, SS-18SM/GTX  
SS-10RA  
SS-12RA  
SS-18RA  
SS-10SMU, SS-12SMU, SS-18SMU  
SS-10V, SS-12V, SS-18V

Circle (10) on Fast Fact Card



THE  
INDUSTRY'S  
FINEST  
LIGHTNING  
PROTECTION  
PRODUCTS



## SX SERIES

- Low VSWR and Insertion Loss
- dc Blocked
- Multi-Strike Capability
- Cellular, PCS & Wireless Local Loop Frequency Ranges Available
- Industry's Best RF Performance
- Maintenance Free
- Fully Weatherized Housing



[Actual Size]

**PolyPhaser®**

A SMITHS INDUSTRIES COMPANY

P.O. Box 9000, Minden • NV 89423-9000 USA  
Tel (800) 325-7170 (775) 782-2511

Fax (775) 782-4476 • www.polyphaser.com

ISO 9001 CERTIFIED

Circle (11) on Fast Fact Card

## LETTERS

### Schools and communications

I spent 12 years in law enforcement and the last 27 years with Motorola and am now retired. I live in Jefferson County (CO) and, in fact, was raised here and also have three sons that are from this area. I enjoyed your article ("Elementary—Not Secondary," *Editorial Forum*, July 1999). Schools not only need to look at what they have done over the years and how they used a communications system, but what it was designed for and who was trained to use the system. Most school administrations are like a fire alarm—until it is used they forget what it is for or when to use it. The biggest problem in the Jefferson County tragedy was with the local communications systems. They could not talk to each other, and some agencies could not even talk to themselves. They had a lot of chiefs and no Indians. Over the years, standards have been talked about (Project 25 and others), and with all the money spent, there is still a problem. Frequencies should not be a problem. At this time, the challenge is understanding the problem, use of standards and working together to solve all this. It has not been solved over the last 30 years, and you and I will never see it solved today.

Over the years I have spent 90% of my time working with the government in the communications field, and the problem you talk about has been here all this time.

—Jan A. Burton  
J-B Burton Enterprise  
Denver

### FCC forms too time-consuming

Years ago, I used to refer to people, or groups of people, who seemed to be out of control and making a mess of things, as "having run amuck." Last month, while attending the National Forestry Conservation Communications Association Conference, and reviewing the latest Form FCC 601, it occurred to me that someone out there "has run amuck."

The pile of papers that I was given at the conference was roughly 1/2" tall. In that pile of papers, it states that in order to modify a conventional two-way land mobile station license, I will need to fill out as many as 10 pages of forms and follow the rather lengthy instructions contained in the 1/2"-tall pile of paper. In the "Notice

to Individuals Required by the Privacy Act of 1974" and "The Paperwork Reduction Act of 1995," which were included in the pile, the FCC indicates that the average time needed to prepare a response (application) was 1.25 hours. I have read most of the instructions, gathered required information and filled out many forms, but have as yet not been able to get my time down to less than two hours per application. It saddens me to think that I'm that much below average, at least according to the FCC.

Filling out a request to modify a conventional two-way land mobile station license used to be a fairly simple process and only required that we fill out a single sheet of paper. Now we are being told that the application process is to be computerized and that we will soon be able to file electronically. I hope the FCC will do a better job of keeping the process simple and minimizing the burden that is placed on the applicant than they have to date.

Some of the information they are asking for seems out of place and has little if anything, to do with frequency management. What does my race, ethnicity or gender have to do with spectrum management? If the FCC desires to collect additional information, it should consider collecting information that would be helpful, such as the frequencies that are used by receivers of two-way land mobile relays and duplex stations. Providing this information to the frequency coordinators could help enormously in avoiding interference problems.

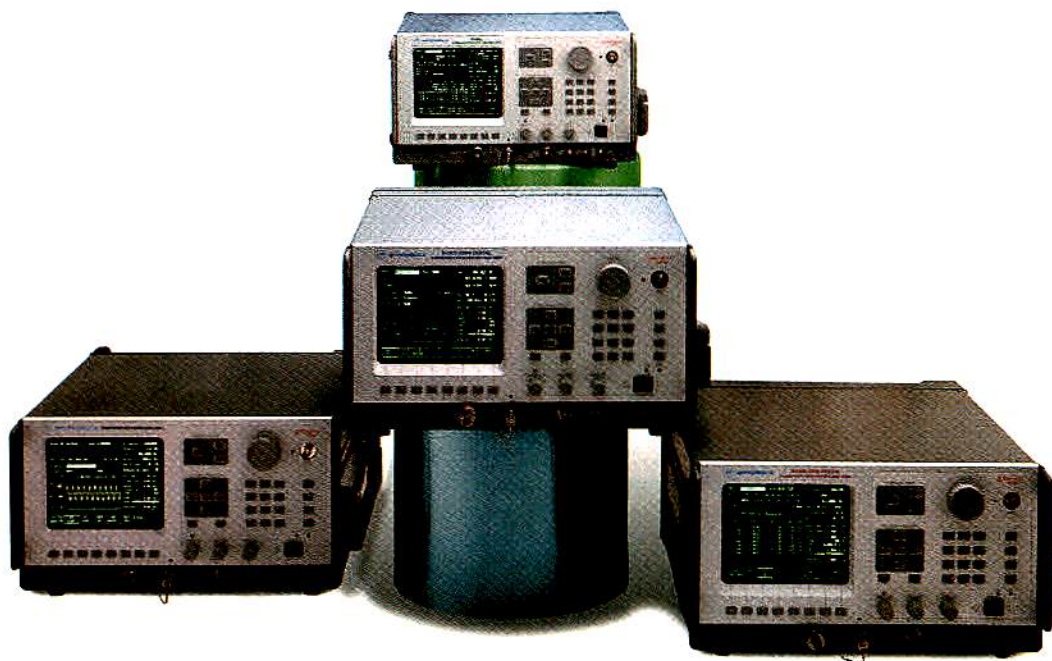
When I speak with FCC representatives about my concerns, they tell me that it is required by law, which is handed down to them by our politicians. When you ask a politician why the law, they suggest it is because that is what the people want. For what it is worth, this "people" wants a simpler process that uses fewer resources and provides us with useful information. The present Form FCC 600 and the proposed Form FCC 601 do not fill the bill.

It appears that someone "has run amuck." Is it the FCC, our elected representatives, someone else, or all of the above?

—Everett John Alberts  
Telecommunications supervisor,  
Missouri Department of Conservation  
Jefferson City, MO



# Got a test?



## We've got the Analyzer.

Start with our standard Communications System Analyzer platform, the rugged, dependable, easy-to-use R-2600. As your test needs grow, our upgradeable R-2600 family of System Analyzers is designed to grow with you.

For fully compatible iDEN® equipment testing, we offer the R-2660. For ASTRO®, SmartZone™, SMARTNET™, SECURENET™ and Project 25 systems compliance, you need

the R-2670. And to test MPT 1327/1343, look no farther than the Motorola R-2680.

Whatever the test, we've got the answers. For complete details or a product demonstration, contact us today:

Phone: 800-422-4210

Fax: 800-622-6210

Web: <http://AccessSecure.mot.com/Accesspoint>



Motorola, "M", iDEN and ASTRO are registered trademarks of Motorola, Inc. SmartZone, SMARTNET, SECURENET and "The Test You Can Trust" are trademarks of Motorola, Inc. © 1999, Motorola, Inc.



**MOTOROLA**



It's never been easier to fill in your network

# Message Center Management

Historically, during the days of Lewis and Clark, pioneers were brave explorers who faced daily hardships head-on along the Oregon Trail. These early trailblazers led the way for other settlers to follow. Although not too many uncharted territories are left to explore in the United States geographically, developing technology has brought a whole new breed of explorers and innovators to the foreground.

After nearly 40 years of developing, customizing and building wireless communications networks, Message Center Management (MCM) has earned recognition in the industry as a pioneer and an innovator. Since 1960, the company has provided timely business solutions, including network deployment of transmitting systems.

Today, the company continues to uphold its pioneering tradition via its growing lineup of professional services and simplified site installation. MCM offers a complete package of facilities and carrier services, coupled with a Web-accessible inventory of facilities. From site acquisition to installation, maintenance and management, MCM focuses on customizing its service offerings.

## A rich history

Based in the heart of the Northeast in Hartford, CT, privately held MCM embodies the pioneer spirit that drives the wireless industry. Initially, MCM evolved from wireless network construction. Its founders and president were one of the first land mobile license holders in the wireless industry. As a license holder of paging and SMR frequencies, the company built a network from Maine to Florida, and in the early 1990s, went on to build and launch one of the first nationwide paging networks in North America.

As MCM progressed, it continued to strive to meet customer requests. It was this basic business practice that quickly led to MCM's thriving business of site management.

"Over the years and throughout these builds, property owners began to ask if we could manage their rooftops, towers, water tanks and other structures and bring on other wireless carriers," said Maria Scotti, MCM's director. "Hence, the inception of Message Center Management."

## Facilities services and management

Management of site facilities, tower, rooftop space rental, site selection/acquisition and regulatory zoning consultation are MCM's core services. The scope of the company's management offerings include:

□ **Controlled rooftop access:** MCM has identified safety as its highest priority. "We will make sure the site installation is safe and secure, and provide whatever measures are necessary to restrict site access to unauthorized public and personnel," said Scotti.

□ **Compliance with all local, state and federal regulations:** Local permitting and zoning regulations varies from region to region. MCM relies on its staff's experience to understand local ordinances to make sure its clients are in full compliance. Depending on the nature of the installation, FAA laws may also need to be considered.

□ **No radio frequency interference:** In 1996, the FCC set stringent law and complex regulations prohibiting RF interference. MCM believes that its expertise in this area is a critical ally to its clients to assure that rooftop tenants comply with all FCC regulations. MCM takes specific measures to guard against interference with existing systems

in a building. For rooftops with multiple transmitters, MCM's goal is to prevent transmitter-to-transmitter "intermodulation" interference.

□ **Site management for maximum business potential:** "We have relationships with the industry's largest wireless service providers, allowing not only the ability to effectively manage carrier-owned facilities, but to maximize co-location opportunities" Scotti said.

□ **Professional site management:** The MCM staff includes professionals in site leasing, site acquisition, construction, engineering and contract administration. The company will continue to focus, Scotti said, on offering customers a courteous, professional relationship with a "single-phone call solution" to any issue that may arise.

## Servicing the carriers

Continuing development of wireless telecommunications services and the proliferation of alternative local service providers, coupled with the demand for more communications services, have created a business opportunity where once there was none. Today's carriers, realizing this potential, turn to MCM for guidance in the following areas:

□ **Site acquisition and management:** Carriers rely on MCM's quick site locator service and inventory listings to assist them with eliminating coverage gaps and filling in networks. If a location is outside the company's inventory, MCM's site acquisition services are available to help carriers locate the right sites for their needs. MCM continuously expands its inventory listings. A complete listing can be found on the site locator section of MCM's most recently redesigned Web site at [www.mcmgmt.com](http://www.mcmgmt.com). The QuickSite Locator provides quick access to the company's inventory of rooftops, water tanks, towers and other structures through the country.

□ **Site installation, maintenance and security:** Acting as the construction manager of the site installation and maintenance, MCM can oversee zoning issues, prepare engineering and architectural studies, coordinate local utility services and provide routine maintenance. MCM will supervise equipment installation and ensure property integrity. And, as a final assurance, MCM maintains stringent procedures and systems at all of its facilities to keep its customers' equipment safe.

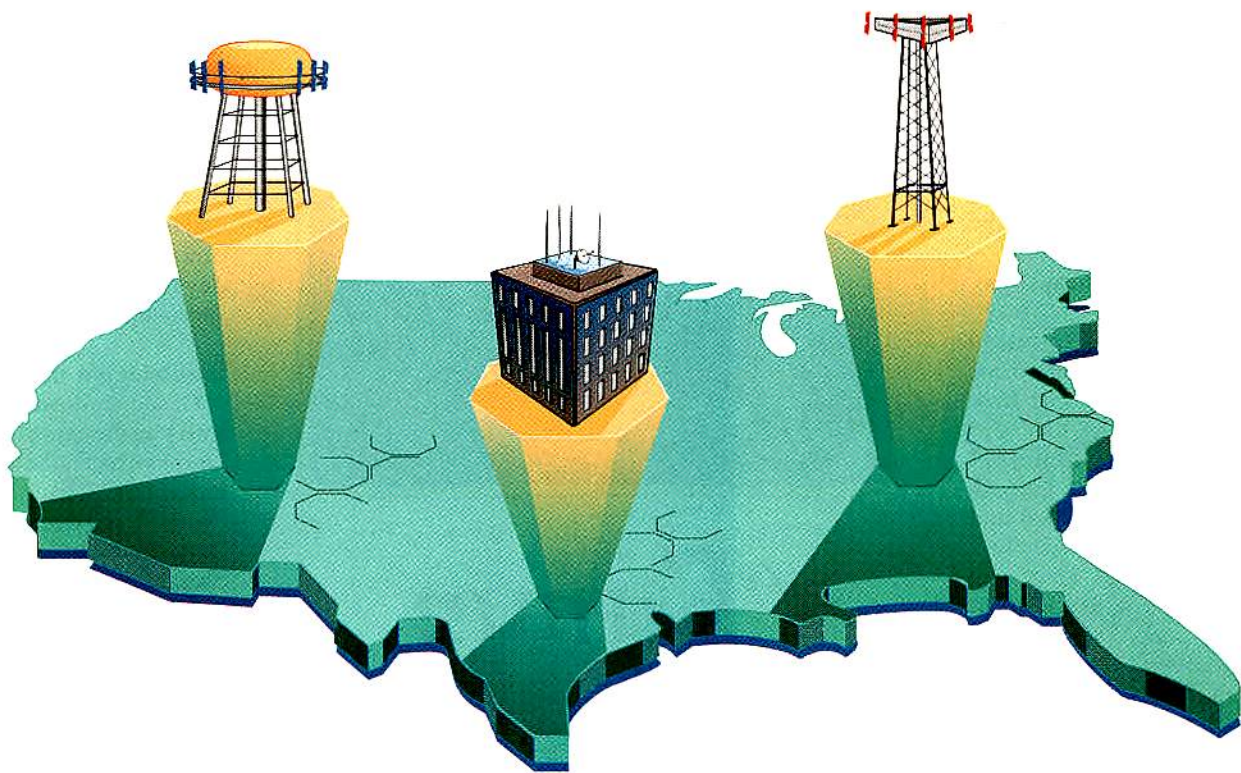
□ **Site intermodulation and RF emissions studies:** MCM reviews all tenant equipment specifications and required RF filters to assure maximum co-location use. New equipment will not be added to the site until all factors have been analyzed and approved. MCM provides intermodulation, RF emissions control, OET-65 compliance, FCC/FAA compliance and inventory control on all of its sites.



Message Center Management • 40 Woodland St. • Hartford, CT 06105  
Tel: 800-235-9868 or 860-278-1174 • Fax: 860-418-5762 • Web site: [www.mcmgmt.com](http://www.mcmgmt.com)



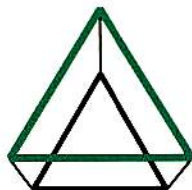
# It's Never Been Easier To Fill In The Blanks.



MCM makes it simple to fill in your network. We have the locations and inventory you need - and the ability to provide them within your time frame.

For nearly 40 years, MCM has been a pioneer and innovator in wireless communications. You can count on us to take care of coverage gaps.

Make the call: (800) 235-9868. And let your network be heard.



**MCM**

**Message Center Management**

*Keep Your Sites On Us®*

40 Woodland Street • Hartford, CT 06105

[www.mcmgmt.com](http://www.mcmgmt.com)

Circle (13) on Fast Fact Card



# Mexican standoff

By Robert H. Schwaninger Jr.

If you've ever had the FCC inspect one of your facilities, you know what it's like to have the *federales* come callin'. It usually begins with a telephone call from an FCC field agent who tells you that they will meet you at your site in a few hours.

"Please have copies of your licenses and your station logs ready for our review," the syrupy voice states with faux politeness.

You, of course, drop what you're doing and rush to the filing cabinet, where you're sure the licenses have been neatly filed. Rifling through the copies, you notice that one of your licenses is missing, and another one doesn't list the right coordinates. Ah—no—that's the one you meant to renew last month.

"What's the expiration date?" you ask aloud of no one in particular. "Darn it! How many mobiles does that say? No! NO! This isn't fair. ... I know—I'll tell them that my old office manager died and took the records with her. Yeah! No—wait! That's no good. 'My dog ate it'? No good. Uh, uh, 'The ERP's so high because I don't know a gain antenna from a granola bar'? Holy moley, this ain't going well already, and they're not even here yet."

A couple of dozen operators enjoyed this thrill last year when the FCC sent inspectors around the Denver area to see how people were using that stuff called "spectrum." What the inspectors were after was evidence of stations that were providing commercial service on private-licensed channels. Did they find evidence? Yes. Did some operators get caught with their proverbial drawers around trembling ankles? Yes. Could this happen to you? Oh, yes.

Schwaninger, MRT's regulatory consultant, is the principal in the law firm of Schwaninger & Associates, Washington, which is counsel to Small Business in Telecommunications. Schwaninger is also a member of the Radio Club of America.

There are many signs that the FCC is beefing up its enforcement efforts across the board. New people have been hired to process complaints. The FCC's Gettysburg office now has enforcement folks in residence. Formal complaints against common carriers and cable TV licensees are actually being processed in less time than it takes to build a battleship out of Popsicle sticks.

So, what should you do? How about ... looking in the darn file drawer *before* the FCC inspects your

[section 90.179]), it would be really keen if your records reflected those sharing agreements. Without the deal committed to paper, it just falls apart. The FCC is going to figure that if the sharing licensees don't have a contract, then they aren't *sharing*. They're just getting commercial service from the two-way shop's repeater.

In general, the FCC is issuing more and more fines, notices of apparent liability (NALs), orders to show cause and letter inquiries under Section 308(b) of

the Communications Act. Licensing with exactitude is being demanded, and failure to keep it current is resulting in fines paid for all transgressions. For example, a local government was fined a few thousand dollars for letting its special temporary authorization (STA) lapse for seven days. Think *zero* tolerance—and get it together.

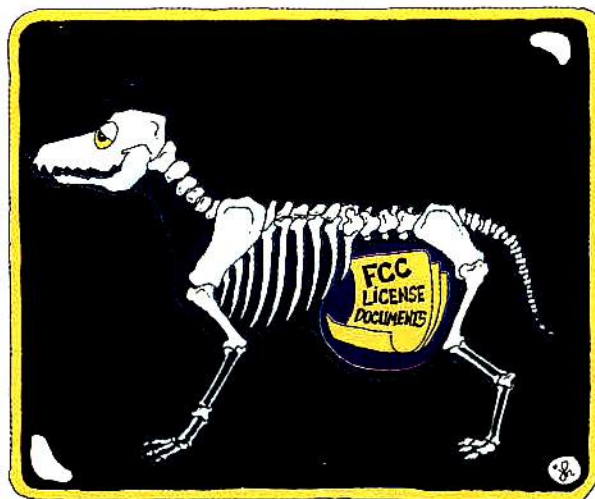
## Bordering on madness

Of course, no matter how well you prepare yourself, "no one expects the Spanish Inquisition." That is, no one expects a call from the U.S. Department of State. One operator, Kwik-Page Communications, Los Angeles, got such a call.

Kwik-Page is licensed to operate a number of 931MHz paging facilities along the West Coast, with a system that stretches from Southern California to Washington on 931.6625MHz. Three of its licensed facilities serve the San Diego area. Unfortunately, the FCC's database only showed *one* of the licenses when the FCC en-

tered into an agreement, called a *protocol*, with the Secretaria de Comunicaciones y Transportes of the United Mexican States to decide how this spectrum would be used within 120km of the border.

When the protocol was announced, the FCC did grandfather the use of all licensed facilities using the channels on the U.S. side of the border. So, the one facility *shown* as licensed to Kwik-Page was allowed to continue to operate.



"Canus  
Excusare  
Absurdus."

Illustration by John Hayes

facilities? What a concept! You would be surprised at the change in attitude the FCC has when you keep your licensing up to speed so that there is some quaint resemblance between the technical parameters on your license and the equipment you are operating.

As for shared facilities (those that are used by more than one private radio licensee and that operate on private spectrum in accord with 47 CFR Part 90 rules



*One filter can't solve all signal interference problems, right?*

**AeroComm, Inc.**  
A Wireless Systems Company

Wrong! Try

# Ultra-Q.\*



- ❖ Improves Fade Margin
- ❖ Adapts to all Receivers
- ❖ Eliminates Paging Interference
- ❖ Compact Size
- ❖ Very High Q
- ❖ Narrow Bandwidth
- ❖ Compatible with any MAS
- ❖ Patent Pending
- ❖ User Friendly Operation

## Filter Specifications

Frequency:	928-953MHz
Gain:	10dB
Bandwidth:	40kHz@3dB 80kHz@60dB
Power Supply:	+12VDC/115VAC
Noise Figure:	<5dB
Frequency Bands:	
50368FS-L	928.00625 to 928.99375MHz 932.00625 to 932.49375MHz
50368FS-U	941.00625 to 941.49375MHz 952.00625 to 952.99375MHz
Channel Spacing:	6.25kHz 12.5kHz 25kHz

**\*We're so confident that Ultra-Q will solve your interference problems, we offer a 30 day trial!**

**AeroComm, Inc.** 560 Sylvan Avenue, Third Floor, Englewood Cliffs, NJ 07632  
Phone: (201) 227-0066 ♦ Fax (201) 227-0067  
E-Mail: [mail@aero-comm.com](mailto:mail@aero-comm.com) ♦ Website [www.aero-comm.com](http://www.aero-comm.com)

Ultra-Q 5/11/98



What about the other two transmitters? Well, according to the State Department, they're not supposed to be operating.

Now we've got a problem that is more exciting than trying to explain to a diplomat what power flux density is. The Mexican government wants the U.S. government to honor the protocol (translation: get Kwik-Page off the frequency). However, Kwik-Page has licenses for its two non-grandfathered stations. The Mexican operators are complaining about interference from Kwik-Page's system. The Communications Act does not allow the FCC to can-

cel licenses without a hearing and other due-process protections. The local San Diego FCC field agent is pulling his hair out trying to find a technical solution. The Wireless Telecommunications Bureau is trying to figure out a solution. The State Department is trying to avoid appearing stupid to the Mexican government. The Mexican government is getting heat from its licensees, who thought the channel would be clean near the border. And Kwik-Page... is trying to serve its customers.

Kwik-Page is getting fed up with the constant assault on its operations by the FCC, the Mexican government

and the State Department. It has tried to accommodate the FCC by configuring one of its stations to direct the signal north, but the efforts have not netted the beleaguered operator any good will. Instead, Kwik-Page is being invited to round after round of discussions to address the problem, even though the solution is simple.

The FCC should simply: (1) admit that it made a mistake in failing to list two facilities in its grandfathering language within the protocol; (2) amend the protocol to protect its licensees' lawful use of the spectrum; (3) provide Kwik-Page with its rights as a commission licensee; (4) respect due process; and (5) stop trying to make Kwik-Page provide the solution to the FCC's own mistake. This method of "We blew it, you fix it" is

**RAIDER**

The  
**UHF Trunking**  
***Solution***

- LTR® Trunking Logic Controller
- UHF Trunking Ready
- CTCSS/DCS Capability
- Repeater Disable Device for Co-channel Protection
- Easy interface and set-up with most repeaters
- Allows conventional and trunking users to share channels
- Interconnect Model Available

**TRIDENT**  
MICRO SYSTEMS

Two Trident Drive, Arden, North Carolina 28704  
Tel (828) 684-7474 • (800) 798-7881  
Fax (828) 684-7874  
www.tridentms.com • sales@tridentms.com

ENGINEERING  
THE  
FUTURE  
OF  
WIRELESS

Circle (15) on Fast Fact Card

**The FCC also entered into the protocol without public notice or even individual notice to affected licensees. If the agency had asked ...**

just not working.

The Kwik-Page situation is not wholly unique. My sources tell me that the FCC has similarly messed up with other 900MHz paging licensees along the border. Are these other licensees playing along, or digging in?

**It's a long road that has no turning**

Here's the irony: The FCC itself clearly states in its auction orders that persons using the FCC database should recognize that the FCC does not warrant the accuracy of the information contained therein, which may, indeed, be incomplete or simply wrong. So, the FCC cannot say it wasn't warned. The FCC also entered into the protocol without public notice or even individual notice to affected licensees. If the agency had asked the licensees affected, it would have been told about errors in the database.

Guessing how this one is going to turn out is kinda' fun. It's as though the affected licensees asked the FCC to show them the agency's station logs for entering into the protocol, and the agency is rifling through its file drawers, saying "We'll just tell the Mexicans that our dog ate it. No, wait! That won't work! How about ...."



# "FIRST TO MARKET" NiMH Batteries

Always Ahead of the Competition!



## Two-Way Replacement Batteries

**Leading U.S. Manufacturer** with over 20 years of manufacturing experience.

**Highest Quality** 95% of all battery packs are manufactured with Sanyo or Panasonic cells.

**W&W Meets or Exceeds** the original manufacturer's battery specifications.

**Customer Service** is a must with W&W. Typically, all orders are shipped within 48 hours, with overnight shipments available.



WHERE QUALITY IS #1

**W&W Manufacturing Co.**

800 South Broadway, Hicksville, NY 11801

In U.S. & Canada 800-221-0732 • In NY 516-942-0011 Fax 516-942-1944

E-Mail: [w-wassoc@ix.netcom.com](mailto:w-wassoc@ix.netcom.com) • Web Site: <http://www.wwassociates.com>

**W&W Europe B.V.** Phone: +31(0) 172-417072 • Fax: +31(0) 172-417080

Circle (16) on Fast Fact Card





# Exploring experienced equipment

For small- to mid-size benchtop operations, a 'pre-driven' piece of test equipment may be financially attractive.

By Matthew Halverson

"Out with the old, and in with the new." It's a time-honored cliché, and one that more than a few people adhere to. There is a certain thrill to buying a new car, a new home or even a new suit that no one has ever driven, lived in or worn, respectively. As long as you don't default on the payments, it belongs to you. Buying 'used' is considered to be the less desirable second option for those who simply can't afford the luxury of a new item. However, in the world of RF test equipment, a few people would like to change the image of used items and show that it is possible to teach an old dog new tricks.

Test equipment is expensive. Spectrum analyzers, oscilloscopes, radio service monitors and other such units can cost from \$20,000 to \$30,000. Although large corporations, like OEMs, have little trouble spending large sums on equipment, it is the smaller service center or maintenance shop, struggling to adhere to a budget, that has difficulty allocating money for expensive analytical devices. That's where the used

Halverson, an MRT intern, is a senior in the journalism school at the University of Wisconsin—Madison. His email address is mghalver@students.wisc.edu.

Photos appearing on pages 20 and 21 were supplied courtesy of RF Imaging and Communications, Martinez, CA.

equipment dealers come in.

"Our main market is 'mom-and-pop' middle-America," said Paul Zeppa, president of RF Imaging and Communications, Martinez, CA. "Price is the number-one reason these smaller companies buy used. These guys can get a unit that is option-rich for 70% of the

**'If it wasn't for price, everyone would be buying new.'**

—Bowman

original cost."

However, a 30% discount is not necessarily the rule. Steve Noll, a test and manufacturing engineer for Advanced Photonix, Camerillo, CA, and who also operates a Web site devoted to used test equipment dealers ([www.big-list.com](http://www.big-list.com)), pointed out that there can be a 5:1 price difference between two identical units sold by two different dealers. "It definitely pays to shop around," he said.

Rick Bowman, owner of Amtronix Instruments, Lakewood, NY, said several factors enter into the pricing of used equipment: everything from the condition in which a unit comes to the dealer who refurbishes it, to the age of the

piece, can affect the used price. In the end, however, the most basic tenet—economics—is the deciding factor.

"Just like with any other product, supply and demand are the biggest things that determine the price," Bowman said. "If no one is buying it, the price is going to go down."

However, Bowman said the proliferation of cellular, paging and two-way radio over the last decade has greatly increased the demand for used equipment among smaller companies.

"The majority of our buyers are smaller to midsize companies," he said. "Price is no doubt the major factor. If it wasn't for price, everyone would buy new."

The growth of these communications sectors has stimulated a greater demand for used equipment, and it has also created a larger pool of equipment from which used equipment dealers can cull their resources. Both Zeppa and Bowman said they get a majority of the units they resell from larger companies that have either gone out of business or shut down a particular division.

"There has been a lot of action in the radio production and RF-related industries lately," Bowman said. "A lot of companies start up, buy new equipment, shut down after five years and then have to sell off that equipment."

## Buyer be aware

Although purchasing used equipment



is an attractive alternative to spending exorbitant sums on new units, Noll offered a few caveats to potential buyers.

"There are two things you definitely want from a used equipment dealer, and most offer them: a warranty of at least 90 days and a right of refusal of be-

cessories or system options, are not as important and can be dealt with on a case-to-case basis.

#### Aesthetics and dealer reputation

The *appearance* of the unit is something else to consider. Zeppa compared the sale of used equipment to the used car industry.

"It's got to look as good as it operates," he said. "If you take it out of the box and it doesn't look good, that creates a bad first impression. It might work perfectly, but if it doesn't look nice, that customer is cursing me every time he looks at the unit."

Bowman said going the extra mile to make an instrument look good is a small price to pay for

the customer satisfaction.

"Cosmetics are very important," he said. "These pieces are expensive enough that we can spend a little extra money to make them look good."

Dealers that do not go that extra mile (or the first few, for that matter) bring down the reputation of the rest of the industry, according to Zeppa.

"You've got a lot of guys in the business that are 'working off their kitchen table,' so to speak, selling for less and not backing up their merchandise," he said. "Luckily, they can't compete because they produce an inferior product."

Bowman had a similar assessment. "A lot of the big companies with lots of money buy new simply for the peace of mind. That's why when you buy used, you have to be cautious. A customer has to have faith in the calibration and the overall performance of the unit."

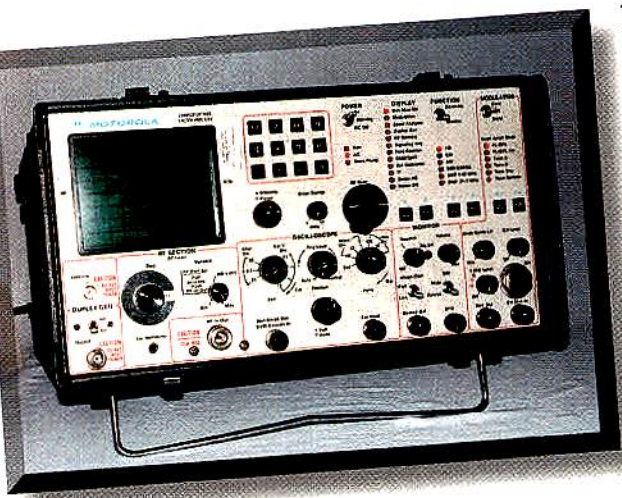
Complicating the used equipment buyer's assessment of a renovated device (and the workmanship that went into its restoration) is the lack of regulation in the used

equipment industry. Both Bowman and Zeppa said regulation could help, but questioned how effectively dealer practices could be controlled.

"There's no real way to regulate the industry because anyone can slap a calibration sticker on their product," Zeppa said. "The ability to offer those warranties and rights of refusal is what sets a reputable company apart from others because if you can't stand behind your product, you can't offer them."

Bowman pointed out other ways to combat the lack of regulation. "There are several new compliance standards for calibration," he said. "The Z540-1 set of compliances tells everything a lab has to do in order to be in compliance, and a lab can be audited by the government to make sure they are in compliance if they claim to be."

Untrustworthy dealers and lack of federal regulation aside, used test equipment offers a viable alternative to companies and agencies without the means to purchase a new instrument. It's fun to take that brand new product out of the box and realize that no one has ever used it before, but there's something to be said for the character and personality of a used item. ■



tween five to 10 days, during which you can return the unit, with no questions asked," he said.

RF Imaging offers a six-month parts and labor warranty and a 10-day right of refusal. Amtronix offers a 90-day full warranty on parts and labor and a five-day right of refusal. Noll says both plans are well within the parameters for a reputable dealer.

Another important question to ask, according to Noll, is whether the instrument comes calibrated and whether the dealer can provide a certificate of calibration.

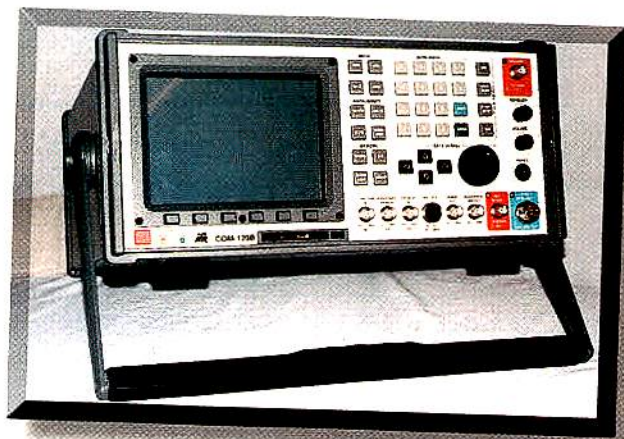
"There are probably a lot of dealers out there that don't calibrate their units before selling them," he said. "It costs a little more, maybe \$50, but it would be very wise to get that certificate of calibration."

According to Zeppa, you can never be too careful when asking about the calibration of equipment.

"I've gotten a lot of equipment, from the dealer network, that is supposedly calibrated, but it turns out not to be," he said. "I just go ahead and 'cal' everything, and everything is performance-tested."

Bowman said it is also important to research the *methods* of calibration. For example, an "NIST-traceable" calibration means that the dealer applied the standards of the National Institute of Standards and Technology. "In this case, you can get paperwork that shows the equipment has been calibrated to these standards," Bowman said.

Other considerations, such as the availability of an operator's manual, ac-







*New hand-held analyzers make field testing easier and more convenient with their decreased size and combination of functions.*

By Yuenie Lau

In the race to offer customers wireless services, carriers continue to add cell sites, both on the hills in the suburbs and on the rooftops of city buildings. Field technicians responsible for maintaining the performance of these cell sites have had to do more testing as a result of this commercial explosion, lugging so-called "portable" instruments to each location. New hand-held test instruments, however, are changing the way technicians look at signals and making analysis easier and less strenuous.

Carriers are expanding services by installing multichannel, multipoint distribution services (MMDS), local multipoint distribution services (LMDS) (currently known as BWA), wireless local area networks (WLAN) and other

point-to-multipoint sites throughout the country, some close to existing cellular, PCS and microwave base stations. Although these services operate at different frequencies, interference occurs often because of the growing number of tower sites. Field technicians are being dispatched to quickly determine the cause of such noise.

Determining if there is a fault, interference or a cell coverage problem at a site adds another task for a single technician, who may already be responsible for as many as 50 cell sites. Worse, the field technician, who receives less training than in the past, may still carry a spectrum analyzer and a vector network analyzer (VNA) to the site. Although both instruments are considered "portable," they are not lightweight—especially after the tenth stop. Most portable lab instruments are not user-friendly by field standards and are tailored to a user who is willing to browse through a thick operating manual to operate the instrument.

Since spring, field technicians for some of the nation's largest carriers have implemented Anritsu's newest Sitemaster analyzers, the S114B and S332B, to solve portability and operational challenges. Both instruments incorporate the testing capability of a spectrum analyzer and a VNA in one unit weighing only four pounds. The units were designed to perform tests much faster and more accurately by providing the spectrum analysis and vector measurement features in a single hand-held instrument.

Spectrum analysis capability is especially important in point-to-point signal analysis because it can be used as an initial test to get a quick review of signal strength. Using spectrum analysis, technicians can determine if there is a hole by checking if signal strength is below the threshold.

The new instruments also address multipath problems. The technician simply walks around the cell site's area with either analyzer to make sure the

Lau is with the marketing department of the Microwave Measurement Division of Anritsu, Morgan Hill, CA.

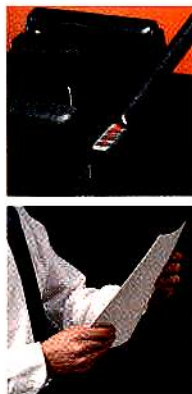


# Advanced Battery Care - Plain and Simple

The **IQ<sup>TEN</sup>** delivers speed and flexibility.

## Programmable Power and Flexibility Without the Programming Effort

Each of five battery test stations is programmed via bar code to test and refurbish the battery with unrivaled speed and accuracy. Enough flexible control and charge/discharge power for batteries with ever-increasing capacities and changing chemistries.



## Simplicity of Operation

- 1: Scan the battery test code.
- 2: Periodically check the printer and pull "test reports."
- 3: Use the reports to pull batteries for re-use or rejection.

## Affordable Expansion

The IQ<sup>TEN</sup> system networks up to 80 batteries on one RCU and printer. A significant battery care program at affordable prices.



Contact  
**iTECH**

9454 Waples Street  
San Diego, CA 92121  
800-233-6868 option 2  
619-458-1500 ext. 2102

[www.itecheng.com](http://www.itecheng.com)

iTECH (Intelligent Technologies) is the leading supplier of OEM battery test systems.

©1999 Intelligent Technologies LLC. The iTECH logo and IQ<sup>TEN</sup> logo are registered trademarks of Intelligent Technologies LLC.

Made in USA.

**itech**  
Intelligent Technologies



signal remains above the threshold. It is much more difficult to do this with a "portable" spectrum analyzer weighing more than 35 pounds.

Portability is also useful when deploying a WLAN or WPBX system inside an office building. In such a scenario, signal holes may not be easily simulated by some site simulation programs because of modeling complexity. A portable analyzer allows a technician to measure the site and to report back to confirm or notify site coverage that differs from the computer prediction.

Technicians are also using the

spectrum analysis feature to deploy a point-to-multipoint site. Most new RF radio designs specify a single outdoor unit (ODU) in which the RF circuitry is integrated with the antenna enclosure. The analyzers are being used to align the customer receiver antennas to the base station transmitter antenna and to ensure no interference signals are present that will impede the radio receiver performance. By connecting an analyzer to the IF output cable from the ODU, the technician can monitor the IF signal strength. Maximum signal level usually indicates the best alignment

path. While in this configuration, the IF cable's quality can also be determined.

Technicians can also assess the performance of a transmitter with the portable analyzers because the spectrum analysis function provides occupied frequency bandwidth measurement capability. Channel power and adjacent-channel leakage power of the radio transmitter can also be determined. The analyzer's 10kHz resolution allows examination of TDMA and CDMA signals from cellular or PCS sites, further aiding technicians as they travel from site to site.

Because field technicians need to perform much more than spectrum analysis these days, the analyzers have been designed with more measuring capability. The units have better than a  $-85\text{dBm}$  noise floor to help technicians quickly determine if there is signal interference. They can conduct all the other measurements that are required in the field, including return loss (VSWR), RF signal output power, cable loss, and distance-to-fault. All these tests are performed at laboratory-quality tolerances.

An RF power monitor option is also being used by technicians. With the option, broadband power can be measured from  $+20$  to  $-45\text{ dBm}$  with  $\pm 1\text{dB}$  accuracy. Power can be measured in watts, in absolute decibels above  $1\text{mW}$  (dBm), in relative power difference expressed as decibels (dBr), or as a percentage.

In addition to having multiple testing features in a lightweight housing, which inherently saves time, field technicians can conduct the tests rapidly because an intuitive and simple user interface guides technicians through the testing process. A menu-driven display requires the technician to make only a few keystrokes to conduct any of the standard tests. Results can easily be read under any conditions, even on cloudy days or at dusk, because the analyzers feature a large, backlit, VGA LCD.

The analyzers are also helping technicians back at the office. All traces can be downloaded to a database for data management or directly to a PC screen. The data can be exported as a metafile for reporting on-site deployment or maintenance. Data can also be downloaded into a spreadsheet for further analysis.

Today's field technicians have had the gauntlet passed to them for installing and maintaining cell sites. With additional sites to monitor and fewer technicians to do it, bulky multiple instruments are no longer sufficient. By using analyzers with spectrum analysis capability, the technicians can now meet the demands of the market: timely analysis on as many cell sites as possible. ■

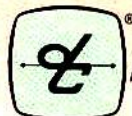
## A SIMPLE COMMUNICATION SYSTEM FOR HIGH NOISE AREAS



Communicating clearly and protecting your hearing in high noise areas is as easy as **1 2 3**. Enhance the performance of your **Two-Way Radio** in loud noise by adding one of our **Noise-Attenuating Headsets** and **Radio Adapter Cords**.

- High quality, rugged Noise-Attenuating Headsets with Certified Noise Reduction Rating (NRR) of 24 dB.
- Over-The-Head or Behind-The-Head style for use with safety caps, helmets, etc.
- Boom-mounted or Throat microphones.
- Voice-Activated (VOX) or Push-To-Talk systems.
- Adapter Cords for over 300 Two-Way Radio models.

For more information and a **FREE demonstration**, call toll-free: **1-800-900-3434**



**David Clark** COMPANY  
INCORPORATED

360 Franklin Street, Box 15054, Worcester, MA 01615-0054 U.S.A.  
TEL: (508)751-5800 E-Mail: sales@davidclark.com FAX: (508)753-5827

©1997 David Clark Company Inc.



T-4



# Discover



## Discover...

**Times Microwave Systems'  
LMR® non-kinking, flexible coax  
communications cable.**



Until Times LMR® flexible communications coax came along, cable installers had to deal with easy-to-kink corrugated copper cable and their hard-to-install connectors or use braided cables with inferior RF performance. Now, LMR flexible communications coax provides superior RF performance, better flexibility and easier to install connectors. The result is better system performance at a lower cost, making LMR coax, connectors and accessories the best choice for all antenna feeder and jumper applications. Discover all the benefits of Times LMR® — call us at 1-800-TMS-COAX or visit our web site at [www.timesmicrowave.com](http://www.timesmicrowave.com).



**TIMES** MICROWAVE SYSTEMS  
A Smiths Industries company



World Headquarters: 358 Hall Avenue, Wallingford, CT 06492 • 203-949-8400, 1-800-867-2629 FAX: 203-949-8423  
International Sales: 4 School Brae, Dysart, Kirkcaldy, Fife, Scotland KY1 2XB UK • +44(0)1592655428 FAX: +44(0)1592653162

[www.timesmicrowave.com](http://www.timesmicrowave.com)

Circle (19) on Fast Fact Card



# Trapping transients: line surge protection

*Data communications lines and equipment are vulnerable to electrical transients. Assessment of the application guides proper surge protection.*

By Alex Gorosito

Today's data equipment is vulnerable to voltage surges and electrical transients. A single IC package can contain more than 100,000 memory bits and

more than 5,000 logic gates. The high sensitivity, due to the small size of the chips used in these packages, makes them susceptible to quick degradation from voltage surges and transients. PLCs, MUXs, HUBs, RTUs, SCADA,

and telemetry equipment are especially vulnerable to electrical surges because of their low operation voltages. Many of these components can be damaged beyond repair by an electrical surge as low as 20V.

Sources of electrical surges are numerous. The most common is a close lightning strike, which will affect nearby data lines through induction. Industrial transients caused by switching and commuting of electrical motors are also significant disturbances. The operation of such devices can cause abrupt shifts in the ground potential that can generate a current flow through a nearby dataline to equalize the ground potential.

Electrostatic discharge (ESD) is another form of an electrical surge that can be included in this group. Although often overlooked, ESD can harm fragile data equipment. ESD is caused by two non-conducting materials rubbing together, causing electrons to transfer from one material to the other. Once the material comes in contact with another object of lower electrical potential, a discharge occurs. Lightning strikes are

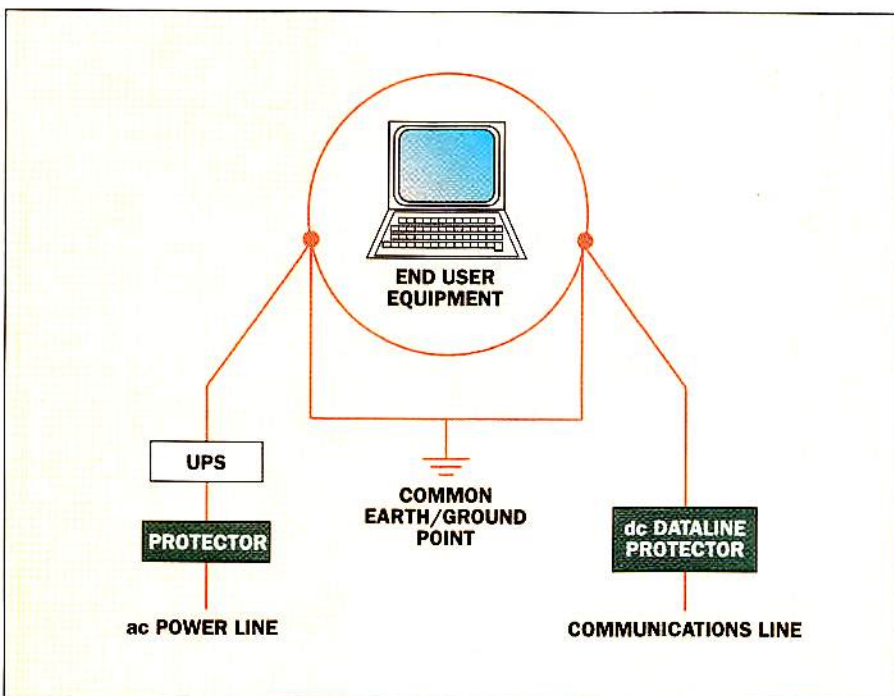


Figure 1. A lightning surge or transient can invade equipment via various routes.

Gorosito is a technical assistant with Citel America, Miami, FL.



## Sample of LT-4900 STANDARD FEATURES

- CSI BASE, an application for your PC that gives you complete local/remote programming control of your system, shows usage graphs and allows remote site monitoring.
- Built-in validator will validate up to 5000 user Id's. Will also validate other controllers on the same system that require external validation.
- Separate airtime accumulators for regular time and prime time per user Id.
- Front panel LCD display shows User Id, Repeater status, error messages, built in test and more.
- Removable Front Panel gives quick/easy access to all adjustments without removing the rack or interrupting service.
- Separate E/E and DID/E&M lines are built in
- Compandor
- Universal overdiol code
- Speed dialer
- Push to connect for selected user Id's
- Two built-in RS-232 ports
- Remote or Local Programming by PC
- Can share channel with conventional repeaters
- Fully LTR® compatible
- Warranty: One year service, five year parts

## OPTIONS

- Voice prompts (user recordable)
- Call detail records
- Built-in Modem (only one needed per system)
- MF Signalling
- Networking

# LTR® trunking on UHF

**Move over Pseudo-Trunking.** Low cost LTR® controllers from CSI and new turnkey UHF LTR® radios (more to come soon plus LTR® conversions for many brands) have just made LTR® the new trunking standard on UHF!

**Real LTR® Trunking** gives you the features and performance formerly only available on 800/900 systems, PLUS eliminates the expense and hassle of installing scan trunk boards in user radios.

**Unique CSI Overlay** allows conventional repeaters to double as LTR® Trunking channels. Simply add an LT-4200 to each repeater. This allows you to phase in LTR® Trunking without adding repeaters or disrupting your conventional service.

**Call Ray Dashner** today for the complete story on CSI UHF/800/900 LTR® Controllers, CTCSS/DCS Tone Panels, Interconnects and more.

**Model LT-4900** for LTR® Dispatch / Interconnect channels. \$1499 dealer net.



**Model LT-4200** for LTR® Dispatch channels. \$649 dealer net.



### NEW Data Logger Option for LT-4200

4200L extends the LT-4200 time/hits logging to include all 5000 ID's. This allows the LT-4200 to log data from other brands of LTR® controllers on the same system.

Toll Free  
Phone  
FAX  
e-mail  
www

(800) 545-1349  
(805) 642-7184  
(805) 642-7271  
sales@connectsystems.com  
http://www.connectsystems.com

In Canada

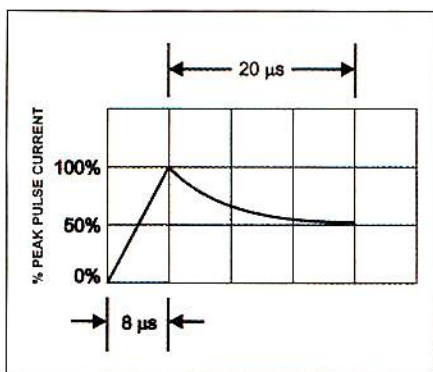
Cartel 800-663-0070  
Hutton Canada 800-265-8685

Circle (20) on Fast Fact Card



**Connect Systems Inc.**  
2259 Portola Rd.  
Ventura, CA. 93003





**Figure 2.** Power-handling capabilities of most surge protectors are commonly tested against a hypothetical surge in an 8/20μs waveform.

the most severe cases of ESD.

The consequences of electrical surges and transients may be severe. Although the event is brief, the amount of energy that is carried can be great. A typical transient event can last from a few nanoseconds to several milliseconds, carrying several thousand volts and at least a few hundred amperes of current. These events may cause burnt line cards, lockups, loss of memory, problems in retrieving data, altered data, and garbling. The user who first thinks of damage in terms of hardware problems or an

ac power-related problem often overlooks all these unfavorable effects.

### Transient suppressors

Any piece of equipment can be considered as having a protective halo around it that can be invaded in two ways: through the power line or through the communication line (i.e., telephone line, coaxial line, RS-232, RS-422, R-485, RS-423, and 4-20mA current loop cables).

Figure 1 on page 26 illustrates how equipment, such as a dispatch computer, should be protected. Both the ac power line and the dc communication line provide direct paths through which voltage surges and electrical transients can travel and damage the equipment. A common mistake is to believe that a surge protector is not necessary on the ac power line because the uninterruptible power supply (UPS) provides adequate surge protection. The main function of the UPS is to provide continuous power for a limited amount of time during a brownout or power outage. Although the UPS may provide some protection, its power-handling capabilities and response times are mediocre at best.

It is also vital that all surge protectors and UPSs be grounded to a com-

mon earth/ground as shown in Figure 1. This avoids differences in ground potentials that may generate a current flow through a nearby dataline to equalize the ground potential.

To protect equipment from incoming surges through the dataline, the user must first determine the electrical specifications of the equipment being protected. Generally, dc communications applications can be broken down into two line-type categories: twisted-pair wires and coaxial cable.

Twisted-pair applications are the most common form of wiring in data communications. They consist of two identical wires wrapped together in a double helix. Both wires in the pair have the same impedance to ground, making the pair a balanced medium. This characteristic helps to lower the wiring's susceptibility to noise from neighboring cables or external sources. A common example of a twisted-pair application is a telephone line. A single telephone line consists of two copper wires: one for transmitting electrical impulses and one to receive them. Coaxial applications, on the other hand, consist of a solid wire core surrounded by one or more foil or braided-wire shields, each separated from the other by a plastic insulator. The

## Geographic Signal Coverage At Your Fingertips.

The STI-9100 Mobile Signal Measurement and Analysis System

**F**rom measurement to report, the STI-9100 is the most cost-effective and easy-to-use signal measurement and analysis platform on the market.

A versatile receiver interface allows for connection to the instrument or application specific receiver of your choice ensuring a long and useful system life.

From Mobile Radio to Cellular, Broadcast to Paging, NPCS to PCS, the STI-9100 is the GPS based data acquisition and analysis platform of choice for measuring communication system coverage and performance.

*The first step toward improving system coverage is to understand current system performance.*



**STI** Survey Technologies Incorporated

"Geographic Signal Coverage At Your Fingertips."

**503-848-8500**

Fax: 503-848-8534

<http://www.surveyttech.com>

Email: [marketing@surveyttech.com](mailto:marketing@surveyttech.com)

17980 S.W. Shadypeak • Beaverton, OR 97007

Circle (21) on Fast Fact Card



inner core carries the signal, and the shield provides the ground.

### Protecting twisted pairs

Once the type of application is determined, the proper type of surge protector must be selected. Whether it is a twisted-pair or a coaxial application, surge protection selection is based on some basic questions. If the application is twisted pair, the four questions the user should ask are:

1. What is the application's nominal voltage?
2. What is the transmission speed of the data that are being passed?
3. What is the application's current rating?
4. How many pairs of these "twisted pairs" does the application include?

In selecting a surge protector, the nominal voltage of the twisted pair application must be known to assign a proper *clamping voltage*. According to Ohm's Law ( $V = IR$ ), voltage is proportional to the current, keeping the series resistance constant. Once the voltage level reaches the surge protector's clamp voltage, the excess energy that may have damaged the dc communications equipment is diverted to a common earth/ground point.

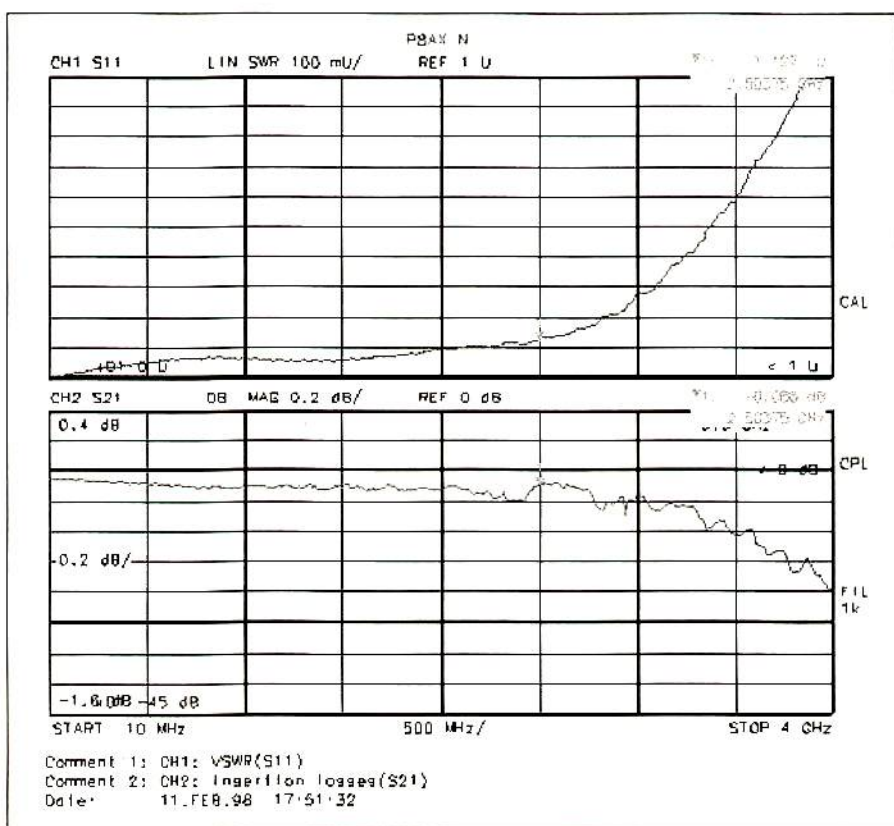


Figure 3: VSWR and insertion loss of a Citel, N-type coaxial surge protector.


As a rule, the clamping voltage of a surge protector should not exceed 1.4 times the application's nominal voltage. Clamping voltages for typical

# PEOPLE FINDER PAGE CENTER

**Now** there's a perfect replacement for all of your **People Finder®** applications — the new **PAGE CENTER™** from Zetron.

- Full Alphanumeric Capability
- Greatly Expanded Address Capacity
- Enhanced Group Calling Capability
- Integrated Two-Way Radio
- 136-174, 260-280, 403-512\* MHz
- 2/4 Watts Output
- Voice Prompts
- FCC Refarming Compliant

\* US sales pending FCC approval.  
® People Finder is a registered trademark of Motorola Inc.



The image shows a Zetron Page Center device, which is a handheld radio with a numeric keypad and a small display screen. The screen displays 'ENTER MESSAGE', 'REPORT OK', and 'STAT'. The device has a speaker and a microphone. The Zetron logo is visible on the top left of the device.

**ZETRON**  
Universal Communications in a Wireless World

Zetron, Inc. PO Box 97004, Redmond WA 98073-9704 USA  
Tel: 425-820-6363 Fax: 425-820-7031 email: zetron@zetron.com [www.zetron.com](http://www.zetron.com)





Photo 1. Surge protector types (left to right): N-type with external ground screw; N-type bulkhead; BNC-type with external ground screw.

applications are shown in Table 1, above right.

In addition to knowing the application's nominal voltage, the transmission speed must be obtained. This information deals with the *capacitance* being placed on your twisted-pair line

by the surge protector. This parameter is important for high-speed data rate applications such as Category 5, 10Base T, RS-485 and T1/E1. Capacitance can cause signal loss, or it can be the *source* of signal reflections if not properly used in a specific data line. To select a

Table 1: Typical clamping voltages of common dataline applications

DATA LINE APPLICATION	CLAMPING VOLTAGE
RS-422	10V
Fire alarms	15V
RS-232	30V
Thermocouples	30V
Leased lines	55V
Telephone lines with ringing voltage	190V

transient voltage surge suppressor (TVSS) device with regards to capacitance and general protection against transient threats, it is recommended that the TVSS be first tested in the circuit under normal operating conditions.

*NOTE: The transmission speed limit of standard data lines such as telephone lines, 4-20mA loops, and RS-232 is about 50kbps. Any application exceeding this limit should be considered a high-speed data (HSD) line, and a surge protector with a low capacitance should be chosen.*

Identifying the *current* rating of the twisted-pair application is just as significant as the transmission speed and clamping voltage. TVSS devices for data lines such as RS-485, 4-20mA loops and telemetry equipment have

## FM BROADCAST KILLER



**FEATURES:**

- Low Loss: <0.5 dB
- Wide Range: to 1GHz
- High Power: 30 watts
- Small: 2" x 2" case
- Reduces Site Intermod
- Eliminates FM from Testing

The C7RFM3x filter is just the ticket for keeping FM broadcast out of your equipment. Because of its high power rating it can be used to keep FM out of transmitters which is a major cause of intermod at sites co-located with FM broadcast. It is also useful when testing antennas at these sites.



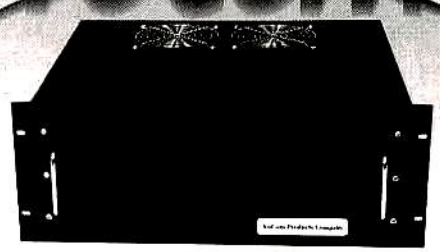
Typical Filter Curve

Please call for FREE application note:  
**"Protecting Sites from Intermods"**

## EAGLE

VOICE: (520) 204-2597 • FAX: (520) 204-2568 • email: eag@sedona.net  
 P. O. BOX 4300 • SEDONA, ARIZONA 86340, USA


# VOCOM





## RF POWER AMPLIFIERS

MODELS AVAILABLE:

- ◆ VHF 130-175 MHz to 500 watts output
- ◆ 230-280 MHz to 100 watts output
- ◆ UHF 400-512 MHz to 350 watts output
- ◆ 800-960 MHz to 200 watts output



847-593-1213  
 FAX 847-593-1320  
 sales@vocomrf.com  
 www.vocomrf.com

Circle (24) on Fast Fact Card



current ratings of about 200mA. Applications that have higher current ratings (e.g., 500mA, 1A, and 2A) will cause premature failure to the surge protector with standard data line current ratings.

While determining the last three parameters, a simpler question must be kept in mind: How many of these twisted pairs need to be protected? Every wire connected to the equipment, even though it may not be in use, provides a path for harmful transients. In today's market, surge protector configurations range from one pair to 200- or 300-pair blocks.

Once all four parameters have been determined, the TVSS power-handling capability, also known as *peak pulse current* or *maximum discharge current*, should be investigated. These terms are defined as the maximum current that the surge protector can withstand for a given pulse duration. Pulse duration can be characterized as the length of time needed for the peak pulse current to reach a maximum value, plus the length of time needed for the peak pulse current to reach 50% of its peak value. Figure 2 on page 28 illustrates an 8/20 $\mu$ s waveform in which the power-handling capabilities of most surge protectors are commonly tested.

The waveform simulates "real-life" lightning-related surges. This is significant because the TVSS must be able to provide a low clamping voltage and be capable of diverting the lightning surge or industrial transient away from the dc communications equipment without short-circuiting.

#### Protecting coax

In a similar fashion, selecting appropriate coaxial surge protection boils down to four questions:

1. What is the application's frequency range?
2. What is the power rating?
3. What is the connector type of the application?
4. Is an in-line mounting style or a bulkhead mounting style preferred?

Coaxial surge protectors are composed of either gas-discharge tubes or quarter-wavelength stubs. In both cases, the frequency of the coaxial equipment must be known. For example, the operating frequencies of PCS and L-band applications are about 1.92GHz and 800MHz, respectively. Gas-discharge tube surge protectors generally have operating frequencies as high as 4GHz with low leakage currents and insertion losses. Figure 3 on page 29 illustrates an N-type coaxial surge protector with insertion losses so low (0.066dB at

2.5GHz, 0.2dB at 4GHz) that the protector is practically transparent on the coaxial cable.

In addition to the frequency of the coaxial application, the power rating must also be known to assign a proper clamping voltage. Standard gas-discharge tube protectors are available to protect power ratings as high as 50W, 400W and 1,000W (continuous). As with the twisted-pair protector, once the voltage level reaches the coaxial surge protector's clamp voltage, the excess energy that may have damaged the dc communications equipment is diverted

to a common earth/ground point.

To connect the surge protector directly to the coaxial apparatus, a compatible connector type must be chosen. Common connector types are N-type, BNC, TNC, SMA and 7/16 DIN.

The installation type is also an issue. Typical mounting styles are available in in-line and bulkhead types. In-line protectors mount directly in-series with the coaxial cable, and grounding is done through an external ground screw that is attached to the body of the surge protector. The advantage to in-line protectors is that they are easy to install and they

## MicroConnect™

### Two-Way Radios for Work and Play



The new PRYME MicroConnect™ line of two-way radios has something for everyone, from professional radio users to weekend warriors. These are powerful portables (5-Watts VHF or 4-Watts for UHF) that are truly palm-sized, measuring just 4.25" tall (excluding antenna)! The radios feature brass reinforced knobs and a metal chassis for durability, and the back-lit LCD display helps the user keep track of the radio's status, even at night. The MicroConnect™ line of portables offers an impressive combination of power and capabilities.

**ProConnect™:** 99 channel transceivers for conventional Land Mobile and Personal Mobile Radio applications. The ProConnect™ is available in three different frequency ranges: VHF Low Band (38-50 MHz), VHF (136-174 MHz) and UHF (440-470 MHz).

**JobConnect™:** 8 channel transceiver for Job-Site use. The JobConnect™ is available in both VHF and UHF versions and comes with the 8 most popular job site frequencies already installed. Additional or different frequencies are available.

**ClearConnect™ and SportConnect™:** These sporty new radios operate on frequencies within the General Mobile Radio Service, and are intended to be used by families for their own personal communications needs. The SportConnect™ is a 7 channel radio for the casual radio user. The ClearConnect™ is a 23 channel unit with repeater capability for the true GMRS enthusiast.

**PRYME®**  
*Radio Products*

by **PREMIER Communications Corporation**

480 Apollo St. #E • Brea, CA 92821 • Phone: 714-257-0300 • Fax: 714-257-0600  
Webpage: <http://www.pryme.com> • Dealer Inquiries Welcome: 1-800-666-2654



are suitable for retrofit applications. Bulkhead coaxial protectors are different only in the way they are grounded. Grounding is done through the chassis of the protector and the excess energy is discharged through the mounting panel. Bulkheads provide better electrical contacts for discharging excess energy from an electrical surge. Photo 1 on page 30 shows two types (with one modification) of coaxial surge protectors.

#### Placement of TVSS

Surge protectors should be installed at both ends of the dc communica-

tions line, whether they are for a twisted-pair or a coaxial application. Once transients have been diverted to earth/ground, they will continue to travel if there is a source of lower ground potential. Transients will travel to that source through the path of least resistance—probably a dataline. If only one end of the dc line is protected, a harmful transient can flow back into the dc communications line if the unprotected end is at a lower ground potential. With protection at both ends, it does not matter where the transient originates. It will always be

shunted to earth/ground, regardless of the difference in ground potentials.

#### Proper grounding

A protection system with a poor ground is the same as having no protection at all. Proper earth/ground connections are often overlooked. Recommended grounds are the utility company ground, a ground rod, well casings, and cold-water pipes that are composed of continuous metal.

*NOTE: Metal water pipes may at times be repaired and/or extended with PVC plastic piping. An interrupting section of PVC pipe nullifies the cold water pipe ground. Thorough investigation of a cold-water pipe is important because the PVC repairs or extensions may be hidden behind drywall, ceiling or flooring.*

Grounds that are unacceptable include sprinkler pipes, PVC pipe, conduit, buried wire and any ground that cannot be verified.

**Grounds that are unacceptable include sprinkler pipes, PVC pipe, conduit, buried wire and any ground that cannot be verified.**

Bonding ensures the most effective ground. Bonding ties all of the grounds in the building together electrically, preventing differences in ground potentials. As a result, it is necessary to ensure that the ground used for the ac power is the same as the ground used for the dc communications surge protectors.

In connecting your surge protectors to a common ground point, all ground wires must be as short as possible. It is imperative that the ground wire not be coiled nor looped. Remember that transients will travel by the path of least resistance. The ground wire should be as straight as possible so that there is no obstruction to earth/ground. Conductivity is a function of wire diameter, as well as composition. The larger the diameter, the better the conductivity of the ground wire. Overall, grounding systems should have no more than 5Ω of earth/ground resistance.

#### Shielded applications

Shield grounding divides into two schools of thought: those who advocate

## I Paid for it the First Time I Used it!

**W**e have heard this from so many customers that we thought we should share the thought with our prospective customers. The CableMate TDR is **THE LOWEST PRICED** true graphical TDR on the market today. This hand-held test instrument will allow you to find multiple shorts and opens in coaxial or twisted pair cables up to 2000 ft. in length. With the industry's best RF filter, you can spot cable problems in the worst RF environments you can imagine. Unlike waveform TDR's, the CableMate TDR is easy to learn and interpret. For experienced users, an external portable oscilloscope may be used for increased sensitivity and waveform analysis.

The CableMate comes standard with an **RS-232 serial computer port**. Optional applications software is available for benchmarking cable installations for future comparison and maintenance. A cable library giving velocity factor and impedance parameters for 66 cables is included. The user can add another 30 cables or change the existing cables listed.

A zoom feature allows the user to closely examine a small portion of a long cable. An exam mode with cursor lets you quickly determine the position of any suspicious fault showing up on the plot. This instrument is also ideal



CableMate™ Graphical TDR

for quickly getting an accurate measurement of the amount of cable left on a reel.

Listen to what our present customers say and **order your CableMate** now so that after the first use you will be saving money with the CableMate every time you use it! For more details, see our web page.

[www.aea-wireless.com](http://www.aea-wireless.com)



A Division of Tempo Research Corporation

Phone: (800) 258-7805 Or (760) 598-8900  
Fax: (760) 598-5634  
e-mail: [aea@aea-wireless.com](mailto:aea@aea-wireless.com)  
1390 Aspen Way • Vista, CA 92083

**The AEA Division of Tempo** specializes in hand-held test instruments for the wireless communications industry.

\* Prices and specifications subject to change



total shield grounding at both ends, and those who are in favor of floating one of the ends of the shield.

The best shield performance is achieved when shield continuity is *not* broken and when shields are solidly grounded with a 360° termination to the chassis of the connected equipment at each end of the data/signal cable. However, the shield will provide a path for power frequency ground loops, which can degrade performance. Floating one end of the shield can eliminate these ground loops, but it can also lead to open-circuit voltages. These voltages can capacitively couple into the "protected" data conductors.

#### Standards and ratings

In some cases, the quality of surge protection is dictated by national or international standards such as ITU.K.22. This recommendation, in particular, seeks to recognize realistic facility transient stresses on telecommunication equipment connected to an internal ISDN T/S bus. The standard covers the following aspects of over-voltage and over-current conditions:

- surges due to lightning strikes on telecommunication lines or to the building housing the equipment.
- electrostatic discharges generated by users touching the equipment or adjacent plant.
- lightning transient surges on mains-voltage power supplies to the equipment.

Using the ITU.K.22 standard to protect facility equipment from transients will result in a protection scheme likely to provide immunity to naturally occurring transients within the facility. Achieving the desired protection will require the engineer to pay close attention to high-frequency events, such as suppressor response to high-frequency transients. The TVSS impulse discharge current rating should be adequate to handle the long-duration transients.

Other standards, such as UL497B, also provide a foundation of how communications line surge protectors should function under certain transient stress conditions. UL497B states that data communications and fire alarm circuit protectors consist of single- and multiple-pair air-gap arrestors, gas-tube arrestors, or solid-state arrestors, with or without fuses or other voltage-limiting devices. It also states that data communications and fire alarm circuit protectors are intended to protect equipment, wiring, and personnel against the effects of excessive potentials and currents caused by lightning in communication

alarm-initiating or alarm-indicating loop circuits.

These industry standards, as well as ITU.K.22 and European markings such as CE, help determine if a surge protector will provide the level of protection required for sensitive communications equipment.

#### Take the proper steps

Data equipment is vulnerable to voltage surges and electrical transients. Users should be aware of the damage voltage surges, industrial transients and electrostatic discharges can inflict on

expensive and delicate communication equipment. Without adequate protection, the door is left open to damaging electrical surges. Steps should be taken to identify the types of dc communication equipment that need protection and to match surge protection to them.

Companies such as Citel America have designed fast-acting, low-clamping, high-discharge surge protectors for all types of dc communications lines. TVSSs can divert to ground all damaging transient voltages while remaining transparent to the system they are protecting. ■

## When Lindgren™ Experience Goes In... EMI/RFI Noise Stays Out.



Design/  
Consultation



Product  
Development



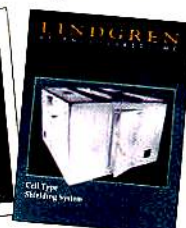
Engineering  
Expertise



Quality  
Testing

**For reliable EMI/RFI shielding performance,** turn to the most experienced manufacturer in the shielding industry: Lindgren. We provide the product development, design/consultation, engineering expertise, and quality testing that result in the most effective EMI/RFI protection and product choices within the industry.

For application assistance or to request our literature, call (630) 307-7200. Visit our website at [www.lindgrenrf.com](http://www.lindgrenrf.com).



**LINDGREN**  
RF ENCLOSURES, INC.

400 High Grove Boulevard • Glendale Heights, IL 60139  
Tel: 630.307.7200 • Fax: 630.307.7571  
E-mail: [lrf@interserv.com](mailto:lrf@interserv.com) • Web: [www.lindgrenrf.com](http://www.lindgrenrf.com)



# Do you cut your coax?

*A benchmark standard approach to installing coaxial cable for mobiles will improve RF power measurements and improve reception quality in fleet vehicles.*

By Patrick E. Buller

Do you cut your coax cable for your mobile two-way radio installations? We at Washington State Patrol (WSP) do. The reason? Repeatable test results.

The Washington State Patrol installs equipment in as many as 500 new vehicles and retrofits more than 100 vehicles each year. During the check-out phase, RF power measurements must fall within WSP standards (e.g., VHF: 100W forward power, 5W reflected power, UHF: 30W forward power and 1W reflected power). If these measurements do not meet specifications, the vehicle is set aside for further investigation to determine the fault. This is the point where frustration begins. The coaxial cables used to connect the radios to the antennas may be random in length. Coax that is terminated resistively with its own characteristic impedance will read "zero" reflected power. If SWR exists, the wattmeter readings will be different for each length of cable.

An antenna cut to exactly one quarterwavelength ( $\frac{1}{4}\lambda$ ) will have a nominal impedance of  $37 + j22\frac{1}{2}\Omega$  (assuming sufficient ground plane). Reducing the length slightly will eliminate the reactive component, resulting in  $37\Omega$  resistance at the base, which yields a VSWR of 1.35:1. Therefore, if the wattmeter indicates 100W forward power and 2.2W or less reflected power, everything is normal.

As shown in Figure 1 above, a  $\frac{1}{4}\lambda$  cable can show an impedance from ground to infinity, depending on its length on either side of the  $\frac{1}{4}\lambda$ . Note also that the impedance repeats itself every  $\frac{1}{2}\lambda$ , except that the phase angle is

different. This feature can confuse the situation.

Consider a cable, less than  $\frac{1}{4}\lambda$  long, that is inductive-reactive. When attached to an exact  $\frac{1}{2}\lambda$  cable, the end result is capacitive-reactive because of the  $180^\circ$  phase shift of the  $\frac{1}{2}\lambda$  cable. It takes

band antenna via a duplexer. During the checkout phase, not all cars met the reflected power standard. Changing duplexers sometimes solved the problem, and at other times changing antennas solved the problem. Soon there were boxes of duplexers and antennas that

would be labeled "GOOD?", "BAD?" and so on. Investigation found the problem to be intricate.

Each individual component—antenna, duplexer and radio—performed according to specifications when tested with dummy loads. Specifications were met when connecting the antenna only to the radio, but when they were connected through the duplexer, a high VSWR was often indicated. When the same test was tried on

another vehicle, it successfully passed the test. The discrepancy was caused by different cable lengths. Although the antenna by itself was OK, the duplexer added a small amount of inductance on VHF that either canceled or worsened, depending on the length of the cable. Similar effects occurred at 450MHz.

The solution was to have all cables cut to an "electrical" multiple of  $\frac{1}{2}\lambda$  to provide a constant reference point whereby each faulty component could be identified. Physical length is unreliable because of manufacturing differences among cable suppliers and varying velocity factors.

## Instrumentation

To correctly establish a reference point, a test cable is assembled to the electrical  $\frac{1}{2}\lambda$ , including the NMO antenna mount

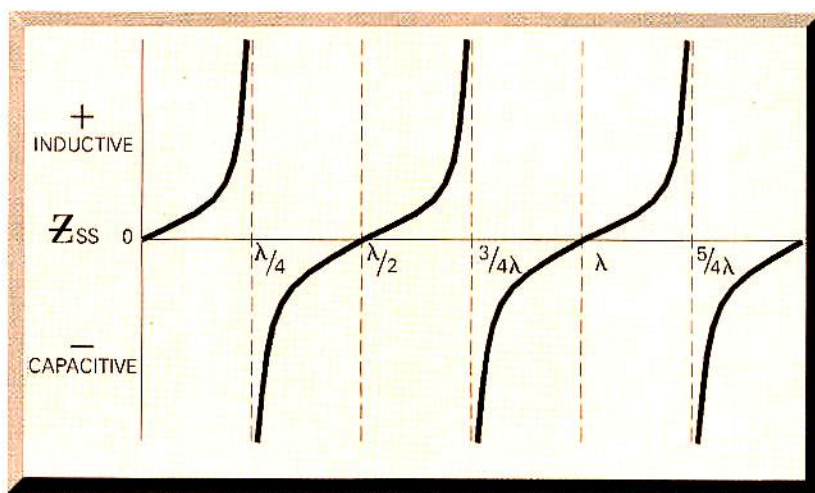


Figure 1. A quarterwave ( $\frac{1}{4}\lambda$ ) cable can show an impedance from ground to infinity, depending on its length on either side of the quarterwavelength.

a full wavelength ( $1\lambda$ ) cable to repeat the exact phase. If the cable length is somewhere between  $\frac{1}{2}\lambda$  and  $1\lambda$ , and not terminated in its characteristic impedance, its impedance can be changed as seen from the sending end because of the  $\frac{1}{4}\lambda$  influence. A  $\frac{1}{4}\lambda$  cable can also be attached as a stub to a cable of the same impedance, adding reactive components, or an open or a short, as determined by the length.

This method was popular many years ago in the CB business when someone used the wattmeter in the reflected mode and began cutting the coax cable from the antenna until the meter read zero. This fooled the transmitter, but the cable mismatch was still there.

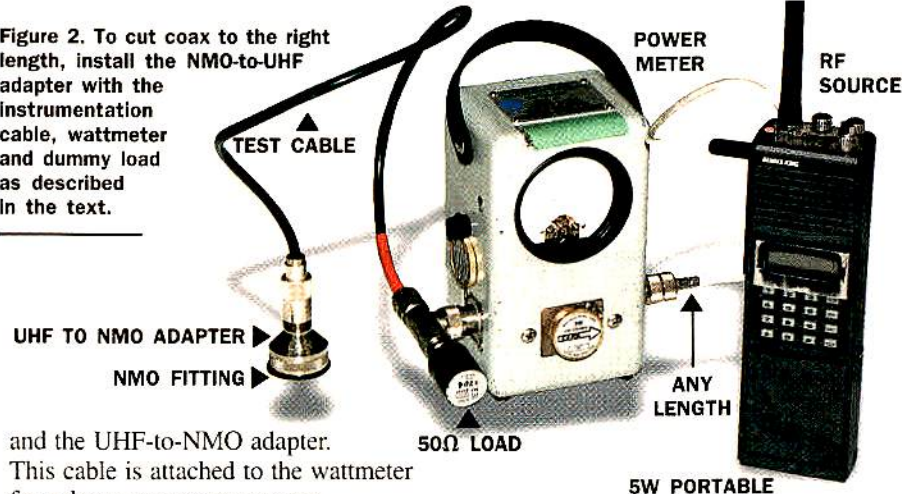
"Ya got yer coax cut" was the catch phrase of the time.

WSP cuts cables to establish a common point whereby all measurements would use the same reference. Case in point: WSP had both 150MHz and 450MHz radios connected to a dual-

Buller is an electronics design engineer for the Washington State Patrol, Bellevue, WA. He is also a member of IEEE, NARTE, RCA, APCO and ARRL.



**Figure 2.** To cut coax to the right length, install the NMO-to-UHF adapter with the instrumentation cable, wattmeter and dummy load as described in the text.



and the UHF-to-NMO adapter. This cable is attached to the wattmeter for subsequent measurements.

Connect a cable to port 1 of a coaxial "tee." Connect a 50Ω resistive (dummy) load to port 2 of the tee. Connect the male side, port 3, to a wattmeter, (one capable of forward- and reverse-power readings), as shown in Figure 2 above. Temporarily connect the other end of this cable to the UHF-to-NMO adapter, and screw it onto a NMO antenna mount. Do not attach cable to the NMO mount at this time. Use a 5W portable radio at the desired frequency as the wattmeter power source for the measurements. Cut the cable until no reflected power is indicated on the wattmeter. The result is an electrical  $\frac{1}{2}\lambda$ , including the NMO mount. You have just set up the lab conditions whereby all further tests will be done.

#### Cutting the coax

Once this benchmark cable is available, the process can begin. The vehicle installation will obviously include a cable from the NMO antenna mount to the transmitter location. To cut this coax to the right length, install the NMO-to-UHF adapter with the instrumentation cable, wattmeter and dummy load as previously described and shown in Figure 2. Apply power to the wattmeter and note the reflected power. Cut the coax cable in small segments ( $\frac{1}{4}$ "") until the wattmeter reads "zero" reflected power. At that length, the cable is a multiple of an electrical  $\frac{1}{2}\lambda$ . The  $\frac{1}{2}\lambda$  cable is open where the cut was done, which reflects to the wattmeter an open circuit that does not affect the 50Ω fixed load.

Now install the proper connector on the transmitter end of the cable and connect this end to the appliance of your choice. If you are now curious about the velocity factor of the cable, measure the physical length and compare it to the  $\frac{1}{2}\lambda$  formula of  $5,905/\text{MHz}$  in inches. The quotient divided by the physical cable length is the velocity factor—usually 0.66 for most coax and 0.8 for foam.

Because the cable is some multiple of  $\frac{1}{2}\lambda$ , all measurements will be reasonably accurate. If some component other than the cable is not within specifications, it is easy to replace one or the other items connected on either end of the coax cable.

Note that  $450\text{MHz} = 3 \times 150\text{MHz}$ . A  $\frac{1}{2}\lambda$  for 150MHz is  $\frac{3}{2}\lambda$  for 450MHz. Makes it simple, doesn't it? When using a duplexer for dual-band operation, it is necessary to make the cable connecting each radio to the duplexer also a multiple of  $\frac{1}{2}\lambda$ . Now that everything is compared to a  $\frac{1}{2}\lambda$ , any measurement out of order can be found by replacing the defective component. Should one, by chance, replace a good antenna with a good antenna, test results will be the same. However, replacing one bad component with a good one will yield immediate acceptable results.

Samples of cable lengths of RG8X used in the WSP shop are as follows:

- wattmeter to UHF/NMO adapter, 29.5" (tip-to-tip).
- 450MHz radio to duplexer, 23.0" (tip-to-tip).
- 150MHz radio to duplexer, 21.25" (tip-to-tip).

*Note: The Patrol has found that it is most efficient to use RG8X instead of the normal run of RG-58/U, especially for the 450MHz band. Some vehicle installations have coax runs in excess of 25 feet. Instead of having two sets of cable and connectors, it is easier, and most cost-effective, to have one type each of cable, connectors and crimp tools on the job.*

This attention to detail may seem trivial for the shops having but a few mobile installations per month. However, for "mass production," this concept may prove well worth the effort, especially if one cares about workmanship. Additionally, improving the RF power standards will yield better reception for your fleet vehicles operating in fringe coverage areas.

## COMPLETE SURGE PROTECTION PACKAGE FOR:

- AC power UL 1449 2nd Edition.
- T1/E1 lines.
- COAXIAL lines N, 7/16 DIN, TNC, SMA...

*Ideal  
for Radio,  
Wireless and  
Cellular base  
stations.*



**CITEL**

**1-800-CITEL-4U**

[www.citelprotection.com](http://www.citelprotection.com)

Miami, FL 33169  
(305) 621-0022 • Fax (305) 621-0766  
email: [citel4u@ix.netcom.com](mailto:citel4u@ix.netcom.com)

Circle (28) on Fast Fact Card

## Receive Weather Alerts Automatically

on your 2-way radio system,  
PA system, voice-mail,  
numeric pager or telephone!

- Rack-mount and mobile systems
- Warnings digitally recorded for DTMF access and playback
- Designed specially for demanding Public Safety use

Call toll free 1-888-877-8022  
or visit our Web site at:  
<http://www.thuneagle.com>



U.S. Patents 5,444,433 • 5,574,999 • D,377,795

Circle (29) on Fast Fact Card



## The versatile SINAD meter

By Harold Kinley, C.E.T.

I remember, back when I first started working in the land mobile radio field, that we were taught how to measure receiver sensitivity using the 20dB quieting method. We were also taught to "tune" a receiver using the quieting method along with the plug-in test sets that were generally used for troubleshooting and alignment work. Whatever happened to receiver and transmitter metering jacks and test sets? At some point in the '70s my boss bought a SINAD meter for me to try out. It was Helper Instruments' model S103. My first thought was the old paradigm: "What's wrong with the way we have always done it?" After using the SINAD meter for a short time, I discovered what was wrong was the way we had always done it.

It was a real eye-opener to go back and check receivers that were aligned using the 20dB quieting method against the 12dB SINAD method. Practically all of the receivers that were aligned using the 20dB quieting method had to be "touched up" with the SINAD method to meet specifications.

One of the biggest advantages of the SINAD method is in tuning adjustments that affect the bandwidth of filter circuits. Most bandpass filter circuits in receivers have an impedance-matching

adjustment at their input and output. This adjustment also affects bandwidth. If the adjustment is made using a continuous wave (CW) signal (as it is with the 20dB quieting method), then it is possible to tune the filter for a frequency response that is too narrow to allow the sidebands of a fully modulated FM signal to pass without severe attenuation.

**Practically all of the receivers that were aligned using the 20dB quieting method had to be 'touched up' with the SINAD method in order to meet specifications.**

The resulting distortion degrades the SINAD sensitivity of the receiver.

### What is SINAD?

The acronym SINAD stands for *signal, noise and distortion*. The signal portion of the composite SINAD signal is specified to be 1,000Hz. The SINAD meter contains a sharp notch filter that is (or should be) tuned to notch out the 1,000Hz signal, leaving only the noise and distortion components to be

measured. The setup for performing the SINAD sensitivity test on an FM receiver is shown in Figure 1, below.

If the squelch control is set to unsquelch the receiver with no signal input to the receiver, then the SINAD meter will automatically set the noise output to 0dB SINAD. If the FM signal generator is modulated by an accurate 1,000Hz tone (to about  $\pm 60\%$  system deviation), the composite signal (1,000Hz + noise + distortion) will be present at the input to the notch filter inside the SINAD meter.

An AGC amplifier is used to keep the composite signal at a constant level at the input to the notch filter, regardless of the makeup of the individual components of the composite signal (see Figure 2, below). As the signal level to the receiver input is increased, the signal component (1,000Hz) becomes a greater part of the composite signal at the input to the filter. At the same time, the noise component is reduced. The notch filter removes the 1,000Hz component, and the remaining noise and distortion components appear at the output of the notch filter and are measured by the metering circuit.

The point where the remaining noise and distortion components are reduced by 12dB below the composite signal is the point where the -12dB SINAD sensitivity of the receiver is taken. At this point, the RF level of the signal generator is the -12dB SINAD sensitivity of the receiver.

Once the -12dB SINAD point is determined, the *modulation acceptance bandwidth* should be measured. The RF level from the generator is increased by 6dB (double the microvolts). This will improve the SINAD reading to something better than -12dB. Now, increase the deviation until the SINAD meter again indicates -12dB SINAD. At this point, the deviation level of the generator is taken as the modulation acceptance bandwidth of the receiver. It is stated as  $\pm "X"$  kHz. Check the level against the

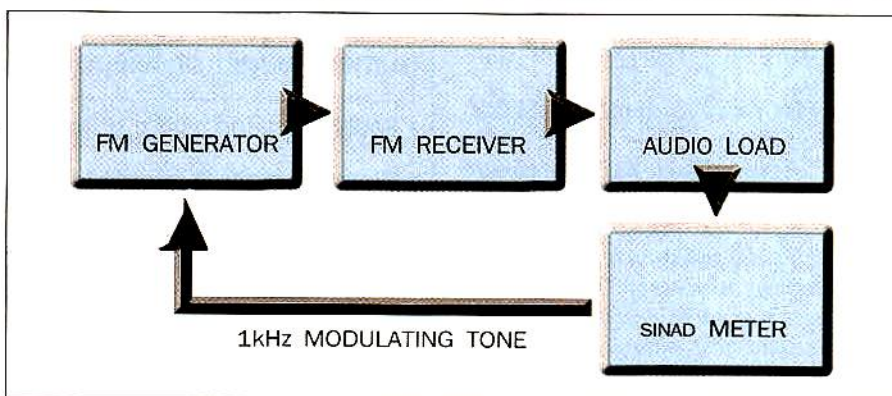


Figure 1. This is the basic test setup for measuring the -12dB SINAD sensitivity of a receiver.



Figure 2. Basic block diagram of the SINAD meter. The 1kHz tone is removed by the notch filter leaving only the noise and distortion components to be measured.

Contributing Editor Kinley, MRT's technical consultant and a certified electronics technician, is regional communications manager, South Carolina Forestry Commission, Spartanburg, SC. He is the author of *Standard Radio Communications Manual, With Instrumentation and Testing Techniques*, which is available for direct purchase. Write to 204 Tanglewyld Drive, Spartanburg, SC 29301.

Kinley's email address is [hkinley@home.com](mailto:hkinley@home.com).



specifications for the particular receiver.

### Measuring distortion

The SINAD reading can be converted to percent distortion. To check the distortion figure of a receiver, the signal generator is set to a high RF level (500 $\mu$ V–1,000 $\mu$ V). This reduces any noise in the receiver output so that the SINAD meter is predominately looking at distortion components. The generator deviation should be set to 50% to 60% system deviation at 1,000Hz. If the receiver is producing 10% distortion, the SINAD reading will be –20dB. The standard –12dB SINAD point represents 25% distortion. To convert from SINAD to percent distortion, use the following formula:

$$D = \text{antilog} \left( \frac{dB}{20} \right) \times 100$$

where

$D$  = distortion in percent

$dB$  = SINAD reading entered as a negative figure.

To convert percent distortion to SINAD, use the following formula:

$$dB = 20 \log \left( \frac{D}{100} \right)$$

The following table converts between percent distortion and SINAD:

SINAD IN dB	DISTORTION(%)
12	25.1
14	20
16	15.8
18	12.6
20	10
22	7.9
24	6.3
26	5
28	4
30	3.2

On some SINAD meters, the scale doesn't allow measurements of SINAD readings below –20dB SINAD. Other instruments allow readings better than –30dB SINAD. A receiver's distortion level should be measured at its rated audio output. It is a good idea to check the distortion level of a receiver before performing the SINAD sensitivity check. If the distortion level is high, the –12dB SINAD point may not be achievable.

### Audio power output

Because the SINAD meter has a root-mean-square (RMS) voltmeter, it can be used to set or measure the audio output power from a receiver. If we know the load impedance and RMS voltage, the power can be calculated from

	1W	1.5W	2W	2.5W	3W	3.5W	4W	4.5W	5W
2.0 $\Omega$	1.4V	1.7V	2.0V	2.2V	2.4V	2.6V	2.8V	3.0V	3.2V
3.2 $\Omega$	1.8V	2.2V	2.5V	2.8V	3.1V	3.3V	3.6V	3.8V	4.0V
8.0 $\Omega$	2.8V	3.5V	4.0V	4.5V	4.9V	5.3V	5.7V	6.0V	6.3V

$$P = E^2 \div R$$

where  $P$  = power

$E$  = rms voltage

$R$  = load impedance

The formula can be rearranged to calculate power from voltage as

$$E = \sqrt{PR}$$

The above table converts power to voltage at several values of impedance.

A non-inductive audio load should be used at the output of the receiver with the SINAD meter connected across the load resistor. The SINAD meter can be switched from RMS voltage measurement to SINAD measurement to measure



- 2 Year Warranty
- User/Installer Manual Included
- IA Quality and Support

#### NEW

#### Model IPE2500 with Line Select

- Integrated Paging Encoder
- 16-Frequency/Function Control
- 4 Programmable Buttons
- Supports up to 4 Control Lines
- Each Line to Operate in 2 or 4 Wire Mode Independently of Each Other
- Mute Unselected Rx on Tx
- All Mute
- Multi-Select Capability
- Vox Indication Per Line
- Separate Select and Unselected Volume Adjustments



Model IPE2500

#### NEW

#### Model ITD2000 LTR<sup>®</sup> Trunking Deskset

- Remote Desktop Controller for LTR<sup>®</sup> Trunking Radios
- Operates on Two-Wire, Voice-Grade Leased Lines
- LCD Shows Selected System and Group or System/Group Aliases
- Standard DTMF Keypad



Model ITD2000

LTR<sup>®</sup> is a registered trademark of E.F. Johnson Company

Please contact us for more information on our complete line of Dispatch Solutions



**GAI-TRONICS  
CORPORATION**  
A Salient 3 Company

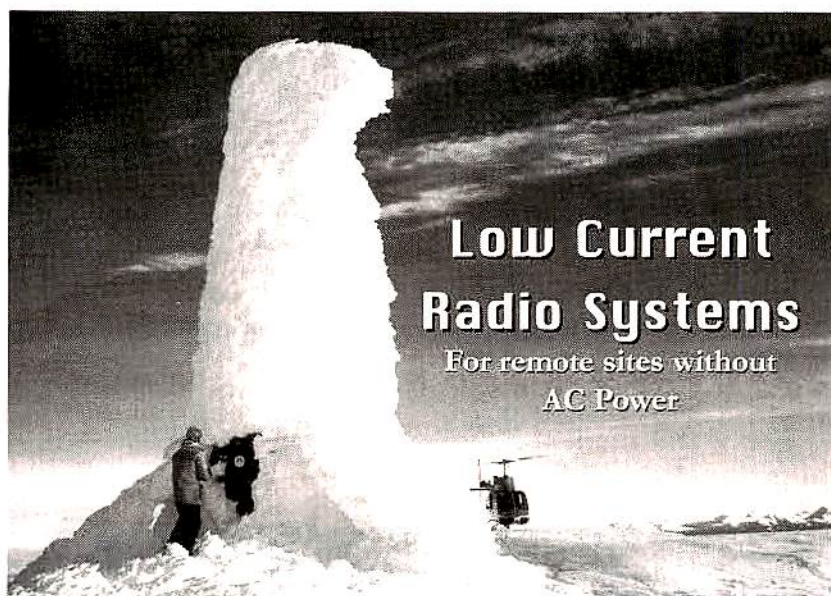
Voice: 888.254.9155

Fax: 504.469.6170

Website: www.gai-tronics.com

Circle (30) on Fast Fact Card





## Low Current Radio Systems

For remote sites without  
AC Power

### Synthesized and Crystal

- Base Stations and Repeaters
- 29 - 960 MHz
- Compact Crossband Systems
- High Reliability
- $-40^{\circ}\text{C}$  to  $+60^{\circ}\text{C}$  (no degradation)
- Fast response, no sleep modes

**DE DANIELS®**  
ELECTRONICS LTD.

Call: 800-664-4066 or 250-382-8268  
Email: sales@danelec.com  
Web: www.danelec.com

Circle (31) on Fast Fact Card

## Need Remotes?



Call us.



DC Remotes  
DC Termination Panels  
Tone Remotes  
Tone Termination Panels  
Local Extensions  
Multi-Channel Remotes



941 Hensley Lane • Wylie, TX 75098  
Voice (800) 869-9128 • Fax (888) 437-5360

Circle (32) on Fast Fact Card

the distortion at any power level within the receiver's audio output range. "Technically speaking," the  $-12\text{dB}$  SINAD measurement should be made with the audio level from the receiver at least half of the radio audio output power level. This is in accordance with EIA specifications.

### Additional applications

Other uses of the SINAD meter include signal tracing in audio stages of the receiver or transmitter. Stage gain measurements can be made easily because the SINAD meter is capable of measuring audio voltage below  $10\text{mV}$ . The SINAD

**Other uses of the SINAD  
meter include signal  
tracing in audio stages  
of the receiver or  
transmitter.**

meter also can be used to send a tone over a line (remote control line), while a second SINAD meter at the other end measures the tone level. The far end should have a  $600\Omega$  termination. If a  $0\text{dBm}$  tone is injected in one end, and the SINAD meter on the other end indicates  $-16\text{dBm}$ , then the line has a  $16\text{dB}$  loss. The measuring instrument can be switched to the SINAD position to measure any distortion on the line. Be sure to use  $600\Omega/600\Omega$  isolation transformer between the instrument and line on both the *generate* and *measure* ends of the line. This prevents unbalancing the line, causing a hum problem.

### Calibration: a final detail

It is important to make sure that the  $1,000\text{Hz}$  tone that is used for any tests with the SINAD meter is accurate. If the tone does not fall deep into the notch of the instrument, valid SINAD measurements cannot be made because the tone itself will be seen as noise and distortion. Make sure that the SINAD meter automatically zeroes with only noise at the input. Internal adjustments are provided to properly zero the SINAD meter and to properly adjust the notch or set the audio tone to exactly match the notch filter.

These are just a few examples of the SINAD meter's versatility. There are many more uses for this instrument, limited only by the imagination of the user.

Until next time—*stay tuned!* ■



## Ericsson PRS offers new radio products with digital modulation

Ericsson Private Radio Systems has rolled out new radio communications products with digital modulation, along with adding to its conventional and enhanced digital access communications (EDACS) systems.

The new digital products, called Provoice and Jaguar, are a next generation of digital radios that accompany the company's Aegis line. Conventional analog FM products are marketed under the Panther brand.

"As for the Provoice digital modulation, it uses the 'improved multiband exciter' (IMBE) voice encoder, or vocoder," said Dominick Arcuri, vice president of engineering at Ericsson PRS.

A vocoder converts a voice into a digital code. The comparable Aegis product uses the AME vocoder.

Provoice equipment has been installed in central Virginia; Ottawa-Carleton, CA; and in Vancouver, British Columbia. Installations are in progress for Coral Gables, FL, and Albuquerque, NM. The equipment has been selected for San Antonio, but no contract has yet been issued.

Another new product, the EDACS 500M trunked mobile transceiver, straddles the EDACS and Provoice applications.

"It has mid-range features and is competitively priced," Arcuri said. "It works with EDACS or Provoice. It will carry data communications. It fits trunked data applications, including work-order

dispatch and traffic inquiries."

Arcuri said that Ericsson has installed 450 EDACS systems worldwide. He said that Florida Power and Light had signed a contract in May for a 45-site, 900MHz EDACS system.

Some military agencies with frequency exclusivity have chosen EDACS for trunked systems. Among commercial customers, EDACS use is more common in the upper UHF-T band.

Ericsson PRS focuses on trunked radio for public safety and on conventional radio for business and industrial (B&I) customers. It does not offer trunked B&I radio, including decentralized trunking. Some SMR system operators use EDACS, although some others consider it to be too feature-rich and too expensive for "plain-vanilla" dispatch services.

Within this focus, Ericsson also provides trunking systems to utility companies, which can be considered industrial or public safety customers. **DB**

### Ericsson EDACS users in North America

53 utility companies  
76 SMR system operators  
104 public safety agencies  
12 airports  
20 commercial users  
21 federal agencies

## Motorola, Johnson affiliate for sourcing, licensing

Motorola, Schaumburg, IL, and the EFJohnson subsidiary of Lincoln, NE-based Transcrypt Secure Technologies will work together on licensing and sourcing of land mobile radio products.

Under terms of a memorandum of understanding announced Sept. 7, Motorola will license the LTR-Net protocol from Johnson. LTR-Net provides enhanced features and wide-area networking for SMR service providers and is compatible with many LTR radio systems. Motorola already supplies LTR-compatible radios.

"We expect a favorable impact to our bottom line in year 2000 and beyond from these new business initiatives," said

Transcrypt Chairman Michael E. Jalbert. "Our companies have previously entered into agreements for intellectual property rights related to Motorola's Smartnet, Smartzone and Project 25 technology."

Among Transcrypt's new products for 1999, Johnson introduced the LTR-Net system, and Transcrypt Secure Technologies introduced encryption modules for mobile radios, including the latest Motorola models. It introduced voice security modules for Nokia and Qualcomm cellular phones.

Johnson plans to introduce handheld land mobile radios and digital mobile radios that meet the Project 25 standard. **DB**

## Berkeley's Newest Indoor Transmitter & Receiver

*The Lizard*  
1 WATT

### PORTABLE TRANSMITTER

A portable, battery-powered 1 watt transmitter used for indoor coverage testing.

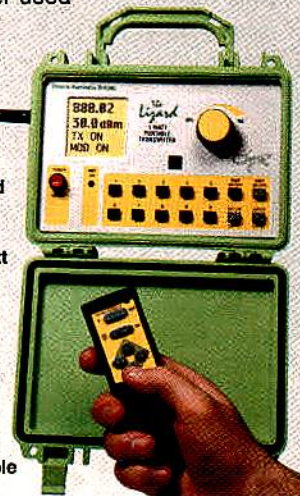
• Self-contained module design

• 1 milliwatt to 1 watt output

• Remote control

• 128 x 128 graphic LCD with backlight

• Removable battery



13 STANDARD FREQUENCIES IMMEDIATELY AVAILABLE!



## MONGOOSE

### HAND HELD RECEIVER

A light weight receiver that's ideal for quick indoor sweeps by propagators.



FREE DeWALT® Radio/Charger with purchase of any Mongoose. One per P.O. Exp. 12/31/99

- Internal memory stores signal strength that can be output to a PC with a serial cable
- Large graphic EL backlit display allows user to view any 3 channels simultaneously
- Rechargeable Ni-Cad Battery
- Audio can be heard through headphone jack or an internal speaker
- Available in most popular frequency formats
- Weighs under 5 lbs. (Including battery)



## BERKELEY VARITRONICS SYSTEMS

Call us today for more information:  
732-548-3737 / Fax: (732) 548-3404  
Internet: www.bvsystems.com  
E-mail: info@bvsystems.com



## FCC Notes

The FCC reassessed the **45MHz CMRS spectrum cap** and the cellular cross-interest rules and found that they "continue to be necessary to promote and protect competition in CMRS markets." The commission did allow more cross-ownership and adopted a spectrum cap aggregation limit **increase from 45MHz to 55MHz in rural areas**. That increase, the commission said, "should facilitate the deployment of service, particularly PCS, to rural areas without presenting a significant risk to competition in those areas." ... Proposals that FCC Chairman **William Kennard** has presented to Congress include **restructuring the FCC** along the functional lines of enforcement, consumer information, licensing, competition/policy and international communications. These functional areas would **replace the current industry-specific bureaus within five years**. Kennard also reported that the commission is developing a plan to allocate and assign as much as **200MHz of spectrum for a broad range of new services**, such as expanded wireless communications services, advanced mobile communications services and new spectrum-efficient private land mobile systems. DK

## Freeman combines service, tower operation

At Freeman Communications, Elmira, NY, servicing radios forms the largest part of the business.

"Some of our customers have bought radios by mail order, and we fix them," said Greg Freeman, one of the owners of the company. Repairs primarily involve antennas and batteries on portables, and antenna components on mobiles.

The dealership, which serves the counties of Chemung, Schuyler, Steuben and Tompkins, sells 100 to 500 radios annually for simplex and repeater communications, including business and industrial, and government customers.

Construction companies account for the largest segment of sales, along with taxi companies, towing businesses, ambulance services and police/fire agencies. The construction companies primarily buy portables.

What began for Freeman 25 years ago as a radio hobby turned into a business. He first sold CB radios with his father and soon converted to selling commercial equipment. Freeman Communications also operates three towers and provides tower space, antenna installation and repair.

Four dealers compete for business in

the area Freeman serves. Yet, a spirit of cooperation exists among them.

"Each occasionally subcontracts installations and service calls with each other to accommodate deadlines and workflow. The dealers cover for each other during vacations and training seminars. We don't steal customers from one another," Freeman said.

Competition from Nextel, cellular and PCS has had no effect on his business, Freeman said. "The economy is doing good, so we're doing good."

Freeman Communications carries Uniden, Maxon and Vertex/Standard products and is a factory-authorized reseller for Zetron, David Clark and C.E.S. The company uses Vertex most often for repeaters and mobiles. Maxon usually is preferred for portables and control stations.

"For mobiles, it depends on the application," Freeman said. "Maxon mobiles are somewhat larger than Vertex mobiles." Word-of-mouth references bring Freeman Communications more customers than any other method, Freeman said.

The company's Web site address is [www.fccusa.com](http://www.fccusa.com). DB

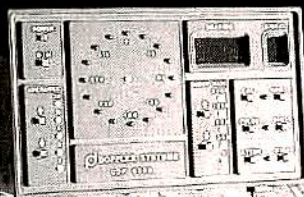
## TRANSMITTER LOCATION

New fixed site direction finders provide 2 degree accuracy, and include software for triangulation from a central control site. Mobile versions also available covering 50MHz to 1 GHz

 **Doppler Systems Inc.**

PO Box 2780 Carefree, AZ 85377  
Tel: (480) 488-9755 Fax: (480) 488-1295  
[www.dopsys.com](http://www.dopsys.com)

European Marketing Director Denis Egan  
PO Box 2, Seaton, Devon EX12 2YS England  
Tel & Fax: 44 1297 62 56 90



Circle (34) on Fast Fact Card

## DESKTOP POWER SUPPLY

with **BATTERY BACK-UP**



Combine one of our low profile desk top LP Series power supplies, a suitable battery, and one of our LPBB solid state battery backup modules to provide a compact, easy to install, low cost UPS.

- 4 LP models available, peak output rated from 10 to 25 "Amps".
- Compact size, 1.75"H x 7"W x 7.62"D.
- LPBB provides seamless solid state transfer to battery power when AC mains go down. Float charges the battery when power is restored.

Contact your communications distributor, or call or fax us Toll Free

**Phone 1-800-467-6741 Fax 1-800-825-1403**

**DuraComm®**  
CORPORATION

203 W. 23rd Ave.  
North Kansas City, MO.  
64116

On the Web at [www.duracomm.com](http://www.duracomm.com)  
Email: [duracomm@duracomm.com](mailto:duracomm@duracomm.com)

Circle (35) on Fast Fact Card





## LAPD upgrades with Motorola

Armed with the power of a new \$21.6 million mobile data system, the Los Angeles Police Department (LAPD) can now simultaneously manage multiple emergencies, such as explosions, earthquakes and fires, in separate parts of the city without compromising communications for ongoing, routine calls. The system, a Motorola 800MHz Private Datacat with Mobile Workstation 520 (MW520) mobile computing devices, is part of the LAPD's upgrade of its Emergency Command and Control Communications System (ECCCS). It replaces a mobile data system the department originally purchased in 1983.

RI

## Pricing brings curious visitors to NTX-Comm's Web site

"They see the pricing, and it gets them curious," said Alan Jackson, owner of NTX Comm Supply, Henrietta, TX.

Jackson was referring to the steady increase of inquiries he receives over the Internet at his Web site, [www.ntx-comm.com](http://www.ntx-comm.com). Even so, site visitors are somewhat reluctant about ordering mobile radios because of the steps needed to program and to install them.

"A local dealer would know the frequencies and tone squelch standards for his area, and he can install the equipment," he said.

Jackson said he sees the industry "tilting" toward product that allows users to program radios. "Installing the radios is not complicated," he added.

NTX caters to local customers, including fire and sheriff's departments. The company sells 60 to 70 radios per year, most of which are used on VHF repeaters by public safety users. Jackson outsources repairs.

Jackson said he got into the business about 10 years ago, responding to friends who were volunteer fire department members.

DB



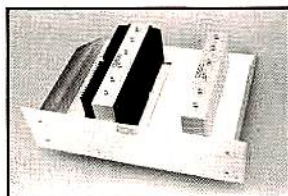
[www.ntx-comm.com](http://www.ntx-comm.com)

Visit us  
on the web at  
[www.mrtmag.com](http://www.mrtmag.com)

- ☐ Relm Wireless readies products for fall, winter production
- ☐ Wilson, Relm? Call Multicom 2-way
- ☐ Dealer: Overcome 'confusion' to raise two-way radio sales

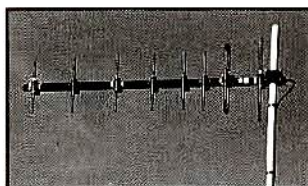
## Radio System Products

### Combiners



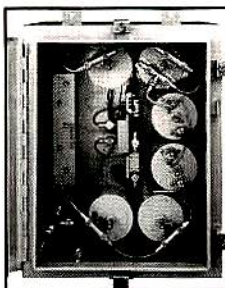
### Duplexers

### Antennas



### Wattmeters

### Tower-Top Preamplifiers



Telewave is now a certified GSA Schedule 70 supplier. (Contract # GS-35F-0248J)  
Contact Telewave today to discuss your system requirements with our sales engineers.

1-800-331-3396

**TELEWAVE, INC.**  
Wireless Communications Manufacturers Since 1972

[www.telewave.com](http://www.telewave.com)

[sales@telewave.com](mailto:sales@telewave.com)

Circle (36) on Fast Fact Card



## News Notes

**Berkeley Varitronics Systems**, Metuchen, NJ, has won a contract from **Telecell One** to provide CW drive test equipment comprised of Gator transmitter and Panther four-band receivers for GSM build-out in Africa. **Texas Instruments**, Dallas, has awarded Berkeley a contract to provide 2.4GHz microcell test tools, including its Lizard 1W transmitters and Mongoose receivers. ([www.bvsystems.com](http://www.bvsystems.com)) ... **Softwright**, Aurora, CO, conducted its ninth annual Terrain Analysis Package engineering seminar Sept. 27-29. ([www.softwright.com](http://www.softwright.com)) ... Melbourne, FL-based **GE Harris Railway Electronics** will use satellite services from **Orbcomm**, Dulles, VA, as part of its Pin-

point locomotive tracking system. "The Pin-point system is poised to transform the way in which the railway industry monitors and communicates with its mobile and remote sources," said **Kevin Clyne**, business development manager, communications systems, for GE Harris. ([www.orbcomm.com](http://www.orbcomm.com)) ... **Relm Wireless**, West Melbourne, FL, reported higher revenues for its land mobile radio products during the second quarter of 1999, up \$1 million, or 16%, compared to the same period last year, thanks to shipments to the U.S. Army. ([www.relm.com](http://www.relm.com)) ... **Emergystat Ambulance Service**, Vernon, AL, has installed a satellite-based dispatch radio network from **SatCom Systems**, Burbank, CA. Explaining why his company uses satellite service for its

two-state region, **Dave Robertson**, Emergystat's vice president, said, "Cellular coverage is unreliable in much of this area on any given day, and terrestrial two-way VHF/UHF radio systems require a significant capital investment in leased landlines and repeater sites for wide-area coverage." ... **Motorola** has appointed **Andrew**, Orland Park, IL, as its global supplier for base station antennas and transmission line products. ... For 9-1-1 emergency dispatch system customers of its Netclock time synchronization equipment, **Spectracom**, East Rochester, NY, has prepared a Y2K emergency procedure for use in preparing contingency plans. It can be viewed on the company's Web site. ([www.spectracomcorp.com](http://www.spectracomcorp.com)) ... **Advanced Charger Technology**, Norcross, GA, has formed nine alliances to distribute chargers for two-way radio batteries in northern Europe. ([www.actcharge.com](http://www.actcharge.com)) ... **CapRock Communications**, Friendswood, TX, offers **Kenwood** and **Motorola** repeaters, mobiles and portables for rent under a new, nationwide dealer subrental program. "We've reduced shipping time and prices," said **John Grau**, general manager of CapRock's Wireless Division. "Kenwood dealers should find our rental program especially advantageous because of our discount program through Kenwood." (888-482-9090) ... For its nationwide fleet, **Gas Supply**, Tulsa, OK, has purchased the **Eaton Fleet Advisor** system with on-board computing, mobile communications, GPS and back-office networking capabilities. Gas Supply's system will use the satellite-based **MSAT** packet-switched data mobile communications network for mobile communications; **Bell South Wireless Data's** terrestrial Mobitex network is another option. Gas Supply's challenge was to convert from regional to centralized dispatching and "still maintain good communications with our drivers and customers," said **Greg Greer**, the company's transportation manager. ([www.fleetadvisor.com](http://www.fleetadvisor.com)) ... **EFJohnson's** Hong Kong sales office has been closed at a cost of \$523,000 for severance expenses and other costs. "We made the decision to close the office as we believe the company will be better served by increasing its focus of wireless sales in the North, Central and South American markets," said **Michael E. Jalbert**, chairman of Johnson's parent company, Lincoln, NE-based **Transcrypt Secure Technologies**. ([www.transcrypt.com](http://www.transcrypt.com)) ... **Nortel Networks** and **Harris** have chosen Signalpro software for broadband system design. The software is provided by Eugene, OR-based **EDX Engineering**. **Wireless Facilities**, San Diego, has also chosen Signalpro to aid in designing broadband systems ([www.edx.com](http://www.edx.com)). ... **RFS Cablewave**, Meriden, CT, will supply cable, connectors and accessories for **Omnipoint Communications'** expanding wireless PCS network. ... **Multiplier Industries**, Mt. Kisco, NY, has received ISO 9001 certification. The battery-pack manufacturer worked for a year and a half to improve and to document its procedures to conform with ISO standards.



**QUICKPAGER**  
Wireless

Industrial Machinery and other Emergency Equipment Monitoring    Temperature Monitoring    Alarm Monitoring



**Professional, Reliable On-Site Paging**

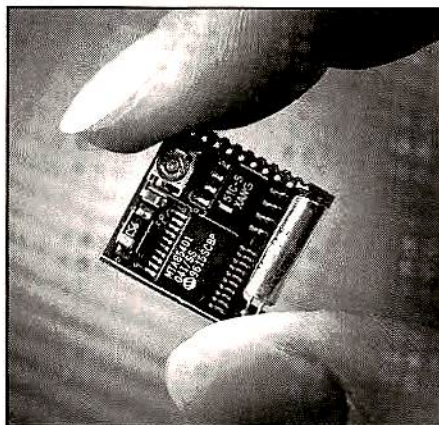
- VHF, UHF Band; POGSAG.
- Frequency Synthesized or Crystal selection.
- 1, 2, or 5 watts.
- Database for 5,000 alphanumeric, numeric, and tone/vibrate pagers.
- Directory for 200 Names.
- To send message, simply type pager ID or Name.
- Programmable repeat transmission to secure critical reception.
- Printer port and Reports included.
- Internal Modem for sending messages to paging carriers or to receive messages from other entry devices.
- Intelligent Voice Prompts.
- Optional PageAlert for monitoring of 16-96 cry contacts.
- FCC USA and DOC Canada approved.

**1-800-387-4237**  
[www.pagingwords.com](http://www.pagingwords.com)

**Canamex Communications Corporation**  
Tel. (905) 475-5557 Fax (905) 475-5568

Circle (37) on Fast Fact Card

## Digital ANI (Unit ID) Motorola® MDC-1200® Format



Micro-Miniature ID-12

Manufactured by Control Signal®, the ID-12 ANI encoder is a cost-effective way to upgrade all the radios in your fleet with ANI that is compatible with Motorola MDC-1200. Works in all radios, and its tiny size (.59" x .65" x .12") allows it to fit in virtually all hand-helds. Has leading and trailing IDs, emergency, and time-out timer. Fleet price (100 qty) \$89 ea. Dealers: Call for pricing.

Call 800-521-2203

**CSC CONTROL SIGNAL**

1985 S. Depew, #7, Denver, CO 80227  
(303) 989-8000 FAX 303-989-8003  
[WWW.CONTROLSIGNAL.COM](http://WWW.CONTROLSIGNAL.COM)

Motorola and MDC-1200 are registered trademarks of Motorola Inc.

Circle (38) on Fast Fact Card



**Jalbert**



## Benchtop equipment

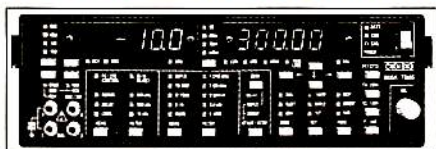
### Battery system offers fast way to test batteries

iTECH's IQten programmable, networked battery test system offers a fast, easy way to test batteries. It features 100mA-2,000mA of programmable power at each battery station. One swipe of the bar code wand programs each battery station. Test reports show all test results and provide a performance receipt at a laser printer. As many as 80 battery stations network to one remote console unit. The system works with



many existing battery adapters.  
Circle (351) on Fast Fact Card

### Test sets maintain radio systems



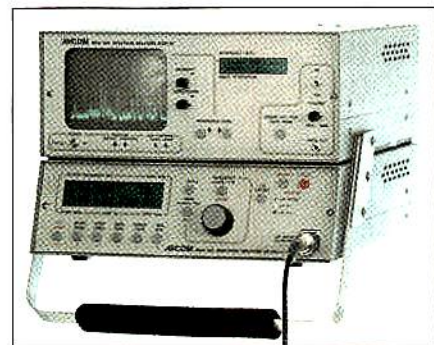
The Convex 806A/TIMS test sets support a wide range of communications systems. These general-purpose instruments are used to install and maintain radio and telephone systems.

A high-precision delay measurement is provided for optimizing simulcast radio systems. The set also measures the ability of the communications facilities to pass signals and quantifies impairments that degrade transmission. The test set comes in rack-mounted and portable/benchtop versions. Convex is represented by Simulcast Solutions.

Circle (352) on Fast Fact Card

### Analyzer offers accurate measurements

AVCOM's MSA-90A microwave spectrum analyzer covers a frequency range of 50kHz to more than 1GHz and uses direct frequency synthesis to assure center frequency measurements to 1kHz accuracy. The ergonomically designed controls allow fast input of operating parameters by using a rotary encoder and simple push-button option selections. Frequency resolution is accomplished by seven IF bandwidth filters ranging from 3MHz to 3kHz. Any selected center frequency can be instantly monitored by pressing one button that sets the frequency span to zero and enables the built-in demodulator and audio amplifier. AM and FM demodulation is



standard in the analyzer. Operating parameters can be easily stored and recalled for later use because of internal memory registers.

Circle (353) on Fast Fact Card

### Radio test set emulates TETRA environments

IFR's 2968 TETRA radio test set performs the on-channel transmitter measurements required in a TETRA production environment. Burst and continuous power measurements, vector modulation accuracy and frequency error are supported. Receiver

measurements are supported by generation of the T1 test signals. The 2968 can also support the main worldwide trunking format (MPT1327), GSM digital cellular and all of the international analog cellular standards.

Circle (354) on Fast Fact Card

New-Tronics Antenna Corp.  
Home of



Antennas

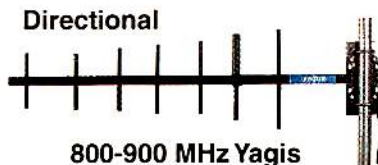
"Beyond Your Expectations"

We have antennas for most applications in frequencies ranging from 25 MHz to 1.4 GHz.



Base Station

Spirit Series Antennas



Directional

800-900 MHz Yagis



Mobile

NMO Style Antennas

**Hustler...**

**Cost Effective Antennas**

New-Tronics Antenna Corp  
1 Newtronics Place  
Mineral Wells, TX 76067  
877-994-9499 fax 940-328-1409  
email : hustler@txol.net  
www.new-tronics.com



## READERS' CHOICE

Of the new products in the April 1999 issue, this one generated the biggest reader response. For more information on this product, circle the corresponding Fast Fact Card number on the card found in the back of this issue, and mail the card to us.

### Modem, amplifier are certified by the FCC



Young Design's model 2400 frequency-hopping, spread-spectrum radio modem and the model AMP2440 pole-mounted, bi-directional amplifier have been certified by the FCC for license-free operation in the 2.4GHz band. Ranges

farther than 50 miles (line-of-sight) can be achieved with modem and amplifier when used with 24dB-gain, grid dish antennas. The radio modem and amplifier have been certified with a range of omni, yagi and grid dish antennas. The radio modem is an RS-232 interface and operates point-to-point or point-to-multipoint at speeds as fast as 115.2kbps asynchronous. The radio modem can be used without the amplifier for short-range links using small whip antennas and several miles using outdoor gain antennas. The radio modem, a waterproof bi-directional pole-mounted amplifier, consists of a low-noise receiver pre-amplifier as well as a transmit power amplifier.

Circle (500) on Fast Fact Card

### Delay timer protects radio equipment

A delay timer from Globe Electric and AC/DC Industries is designed to enhance public safety and industrial communications systems. The delay timer protects batteries, two-way radio equipment, computers and cellphones. The MZL-10 series is a programmable delay timer that starts timing when the voltage starts dropping. This will allow the continuous operation of communications equipment for a preset period of time. A dipswitch allows the user to select or to change the preset period. A built-in voltage detector can override the timer and shuts all connected communications equipment off when the battery is weak. The timer also features high-voltage protection and a diagnostic LED. The compact unit is sealed from moisture and vibration. It operates in the temperature range of -40°F to 185°F and is rated intrinsically safe.

Circle (401) on Fast Fact Card

## Dealers Wanted Full Margin Products



Larsen Antenna Technologies

Portable, Mobile or Base Station, TelePath carries a full line of Larsen Antennas to fit every application.



GAI-TRONICS CORPORATION  
Instrument Associates

Remotes, Desksets, Controllers, Adapters and Telephone Interconnects, TelePath can supply all of your communication needs.



TelePath

49111 Milmont Drive  
Fremont, CA 94538-7347

**1-800-292-1700**

(510) 656-5600

Fax (510) 656-2114

Visit us on the Web at: [www.telepathcorp.com](http://www.telepathcorp.com)

Circle (40) on Fast Fact Card

## WIND POWER

Enhance your PV system with **AIR Industrial**

### Benefits

- Power night and day
- Reduce seasonal fluctuations
- Reduce total system costs

### Monthly Average Output

- 9 mph average: 15. kWh
- 10 mph average: 22.3 kWh
- 11 mph average: 29.6 kWh

### Specifications

- Rated 300 watts
- Only 14 lbs. (6.3 kg)
- 45 inch (1.14 m) blade dia.
- Only two moving parts
- Internally Regulated

**3 Year Warranty**

For distributor and product information, contact:

**Southwest Windpower**

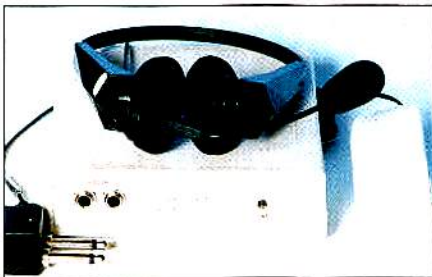
2131 N. First Street • Flagstaff, Arizona 86004 USA  
Tel 520-779-9463 Ext 400 • Fax 520-779-1485  
[www.windenergy.com](http://www.windenergy.com) • E-mail [info@windenergy.com](mailto:info@windenergy.com)

Circle (41) on Fast Fact Card



## Headset adapter for remotes offer small footprint

Ventronics' headset adapter for CPI remotes provide a compact connection for dispatchers. The noise-suppressing headset adapters are compatible with popular tone and dc remotes. The model HA-CPI-FS adapter allows use of any brand or model of PL-237-type powered telephone headset and is fully compatible with the CPI-TR20 and DR20. Features include a small desk footprint and provisions for foot pedal operation. Internal switching and connectors allow for serial con-



nection of remote panels for simultaneous operation.

Circle (402) on Fast Fact Card

## Van antenna system hides in storage pipe



STI-CO Industries' discreet antenna system for law enforcement operations comes in a surveillance vehicle disguised as a contractors' van. Its rooftop "storage pipe" contains a custom-engi-

neered system that includes multiple, working antennas specifically tuned to operational requirements. The system provides upgrade alternatives to existing van installations. The completely disguised tubular enclosures make adapting off-the-shelf antennas unnecessary, and they eliminate the need for multiple external antennas. The antennas have built-in ground planes and require no field tuning. They provide unobstructed omnidirectional communications, unlike antennas used inside the vehicle.

Circle (403) on Fast Fact Card



### Motorola Fire Pagers



Pager batteries and parts



Tone Filters and Reeds



Portable Radio Accessories

**Specializing in:**  
**Pager repairs**  
 Frequency Changes  
 Minitor II Scan Boards  
 Keynote Monitor Boards



Call the experts for all your Paging Needs

**800-822-2180**

Fax: 561-683-0059

International: 561-683-0022

1300 N FL Mango Rd #26

West Palm Beach, FL 33409

<http://www.pwservice.com>



Minitor III and KeyNote are a reg. trademark of Motorola Inc.

Circle (42) on Fast Fact Card



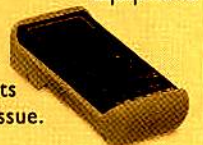
1) DLC specializes in installation hardware, including terminals, screws, fuses and fuse holders, cable ties, battery terminals, relays and more to make your mobile radio install a breeze.

## Why DLC

2) Muth Safety Signal Mirrors are hot and available for a wide variety of vehicles including the Ford Crown Victoria



3) Crimping tools, wire strippers, electronic pliers and cutters, soldering irons, and a variety of multimeters and test equipment.



4) A 48 page flyer with a New Products section coming in each issue.



5) Quick off the shelf delivery

6) Rapid response to domestic and export orders and inquiries

7) Order by phone on our 24 hour fax line.

8) We have an experienced sales staff ready to help you with your orders or questions.



**is**  
**your**  
**First**  
**Source**

**FOR ELECTRONIC PARTS AND ACCESSORIES**



**DAVID LEVY COMPANY, INC.**

ELECTRONIC PARTS AND ACCESSORIES  
 12753 Moore Street • Cerritos, CA 90703 • U.S.A.

NATIONWIDE/CANADA  
 (800) 421-3536  
 ORDER FAX  
 (800) 421-3538  
 LOCAL  
 (562) 404-9998

FAX  
 (562) 404-9698  
 CUSTOMER SERVICE  
 (800) 962-4120  
 E-MAIL  
[dlcbw@aol.com](mailto:dlcbw@aol.com)

Circle (43) on Fast Fact Card



# PARTNER TO YOUR SUCCESS

COMPLETE LINE OF PRODUCTS  
FOR YOUR  
**COMMUNICATION SYSTEM**

ANTENNAS, FILTERS AND SITE MONITORING

200 MHz

400 MHz

800/900 MHz

DIPOLAS

OMNIS

YAGIS

TX COMBINERS

RX MULTICOUPLERS

DUPLEXERS

**davicom**  
technologies

1.877.327.4832

(609) 653.1065

www.davicom.com

Circle (44) on Fast Fact Card

## REPEATER, PAGING & BASE AMPLIFIERS

200 w. UHF Amps under \$1000!

250 w. VHF Amps under \$800!

Why Pay More?

For over 20 years, Henry Radio has been manufacturing low cost, reliable mobile amplifiers. All common brands, power ratings and configurations are available.

Call today for specifications and prices or visit our web site:  
www.henryradio.com

1.800.877.7979



# HENRY RADIO

2050 S. Bundy Drive, Los Angeles, CA 90025

Phone: 310.820.1234 FAX: 310.826.7790

www.henryradio.com

Circle (45) on Fast Fact Card

## Modem, base station deliver high-speed data



Dataradio's Gemini<sup>PD</sup> and Paragon<sup>PD</sup> are designed for private radio networks. The Gemini<sup>PD</sup> mobile data radio modem uses dual receivers to decode messages simultaneously to improve performance in multipath and fading environments. The "parallel decode" technology, along with the DSP-based modem, can produce fewer retries and more effective throughput. Other features include a GPS receiver, as many as 16 over-the-air programmable channels with automatic channel changing and three RS-232 data ports with a built-in multiplexer.

Circle (404) on Fast Fact Card

## Receiver detects RF emissions, alerts user

The RF Bug from National Communications Group is used with an analog or digital phone. It has a circular display of six light-emitting diode bulbs and a small antenna that detects the presence of nearby RF. When exposed to RF (such as an incoming cellphone call) the lights flash in a clockwise direction, silently alerting the user to the active RF field in the area. The RF bug also detects other forms of radio and electronic emissions, such as those from surveillance cameras and hidden microphones.

Circle (405) on Fast Fact Card

## Microwave radios extend channels

The substrate LEDR microwave radio from Adaptive Broadband provides full-duplex, scalable bandwidth and capacity from 64kbps to 768kbps in a 200kHz channel. These radios can operate in a point-to-point environment with a wide range of applications. They are suitable for telecommunications access and transport links, wireless backbones for SCADA systems, and as backhauls to extend existing channels. The radio is designed to connect to any industry-standard EIA-530 or V.35 source.

Circle (406) on Fast Fact Card



## RTU offers 12-bit conversion

The model 1732 remote terminal unit (RTU) from **Zetron** features 12-bit analog/digital conversion for accuracy. It can be expanded in modular increments to a maximum of 445 points with analog, digital and pulse-count inputs for pressure, temperature, flow, power and other sensors while analog, digital and relay outputs interface to valves, motors, alarms, pumps and other controls. Each unit features extensive, on-board user-programmable logic for systems such as pump rotation, communications fail/fall-back control and data logging.

Circle (407) on Fast Fact Card



## Gate lock enhances card access

**Hark Systems'** proprietary lock option is appropriate for Hark's card access system. With the custom-designed lock, existing double-swing gates and personnel gates can be secured with a heavy-duty chain-and-latch configuration. The locking mechanism provides security and access control. The front plate is designed so a card access reader unit can be placed directly on the gate lock, so there is no need for a separate card reader installation. The combination of lock and card access makes this an all-inclusive system with both physical and computer-controlled access to the site.

Circle (408) on Fast Fact Card



# CeoTronics

Audio · Video · Data Communication

Ceotronics, Inc.

2340 Trinity Mills Road

Carrollton, Texas 75006

Tel. (972) 416-9500, Fax (972) 416-9580

## Perfect Communication In Which You Can Trust

For Police, Military, Customs & Excise, DEA, FBI, Security and Crowd Control...

**CeoTronics has the right communication systems**

- For all popular portable radios and cellular phones with connection facility
- Heavy duty headsets with voice activated (VOX) and manual PTT transmitter keying
- Lightweight headsets and earmikes with different PTT options
- Contact-Com, picks up the voice from the top of the head, ideal for helmets, protective hoods and respirators
- TC 917 - UHF wireless heavy duty headset for hands free communication
- Inductive systems for covert communication

**CeoTronics... when it really counts!**

For further details phone or write

E-Mail [headsets@altinet.net](mailto:headsets@altinet.net)

<http://www.ceotronics.com>

Circle (46) on Fast Fact Card

# Get Big Ideas IN BIG D!



**CMA**  
COMMUNICATIONS  
MARKETING  
ASSOCIATION

Join fellow communications professionals at CMC '99,

for big ideas about training and networking for wireless manufacturers, distributors and independent representatives. Sponsored by the Communications Marketing Association since 1973, the last CMC of the century is in Dallas, Texas, November 10-13, 1999 at the Harvey Hotel, DFW Airport.

Every year, CMC is the perfect place for communications manufacturers, distributors and independent representatives to have three days of uninterrupted time for important product training, networking and educational seminars. Why fly everyone to your plant when you can meet with all your independent representatives and distributors at a much lower cost? And, with CMC,

you won't have the distractions of a trade show to interfere with training.

Here's another big idea you can get at CMC: It's the perfect place to discover new lines to rep, learn new distribution methods and to sign up representatives.

Call today to get on the training schedule and learn more about CMC '99. Contact **Jack Armstrong** at (410) 308-0808, fax (410) 308-0809 and email [jaa@baltbiz.com](mailto:jaa@baltbiz.com). Our web site address has all the details, too: [www.commtga.com](http://www.commtga.com). Don't let your competitors lasso all the big ideas for the Millennium, get some of your own at CMC '99.

**CMC '99**  
NOVEMBER 10-13



Circle (47) on Fast Fact Card



**Cliff Tam**, a recent graduate from the University of Nevada, Reno, joins PanaVise Products, Reno, NV, as associate products manager.

**Matt Moseley** of the Atlanta Fire Department, Squad 4, wins the 1999 International Benjamin Franklin Fire Service Award for Valor, sponsored by Motorola, Schaumburg, IL, and the International Association of Fire Chiefs. Moseley demonstrated courage during the helicopter-assisted rescue of **Ivers Sims**, who was stranded on a construction crane 250 feet above the seven-alarm fire at the Fulton Bag & Cotton Mill in Atlanta on April 12.

**Sammy A. Miles**, former president of SigNet Paging, Raleigh, NC, joins In-Touch Management Systems, Melville, NY, as director of sales and marketing.

Changes at Glenayre Technologies, Charlotte, NC:

The company's three operating units, Wireless Messaging, Wireless Access and Integrated Networks, have been consolidated into the following business unit: **Warren Neuburger**, executive vice president of products, previously the head of the Integrated Networks Group, now manages the consolidated product management, engineering and customer service functions. **Bill Edwards**, who previously managed Integrated Networks' sales, becomes senior vice president of worldwide sales. **John Rottenburg**, senior vice president of operations, has responsibility for manufacturing and logistics. **Gary Hermansen**, previously head of Wireless Access, becomes senior vice president and general manager of the consumer products business unit. **Stan Ciepielinski**, previously chief operating officer, resumes that position.

**Ian Maxwell** leaves CommSite International, Vienna, VA, as vice president, site acquisition, to join SiteSafe, Arlington, VA, as vice president of operations.

**Don Jones** departs IBM as director of public sector industry marketing to join Tellabs, Lisle, IL, as vice president of North American sales.

**Andy Merrill** leaves Motorola as field engineering manager for the Western region, headquartered in Carlsbad, CA, to join Metawave Communications, Redmond, WA, as vice president, customer operations.

United States Postal Service

## Statement of Ownership, Management, and Circulation

1. Publication Title <b>Mobile Radio Technology</b>		2. Publication Number 0 7 4 5 - 7 6 2 6		3. Filing Date 9-22-99
4. Issue Frequency monthly		5. Number of Issues Published Annually 12		6. Annual Subscription Price free to qualified
7. Complete Mailing Address of Known Office of Publication (Not printer) (Street, city, county, state, and ZIP+4) Intertec Publishing Corporation 9800 Metcalf Ave.; Overland Park, KS 66212 Johnson County				Contact Person Julie Neely Telephone 913-967-1640
8. Complete Mailing Address of Headquarters or General Business Office of Publisher (Not printer) Intertec Publishing Corporation 9800 Metcalf Ave.; Overland Park, KS 66212				
9. Full Names and Complete Mailing Addresses of Publisher, Editor, and Managing Editor (Do not leave blank)				
Publisher (Name and complete mailing address) Mercy Contreras; Intertec Publishing Corporation 5680 Greenwood Plaza Blvd; Suite 100 Englewood, CO 80111				
Editor (Name and complete mailing address) Don Bishop; Intertec Publishing Corporation 9800 Metcalf Ave.; Overland Park, KS 66212				
Managing Editor (Name and complete mailing address)				
10. Owner (Do not leave blank. If the publication is owned by a corporation, give the name and address of the corporation immediately followed by the names and addresses of all stockholders owning or holding 1 percent or more of the total amount of stock. If not owned by a corporation, give the names and addresses of the individual owners. If owned by a partnership or other unincorporated firm, give its name and address as well as those of each individual owner. If the publication is published by a nonprofit organization, give its name and address.)				
Full Name		Complete Mailing Address		
Primedia Inc.		745 Fifth Avenue New York, NY 10151		
11. Known Bondholders, Mortgagees, and Other Security Holders Owning or Holding 1 Percent or More of Total Amount of Bonds, Mortgages, or Other Securities. If none, check box <input checked="" type="checkbox"/> None				
Full Name		Complete Mailing Address		
12. Tax Status (For completion by nonprofit organizations authorized to mail at nonprofit rates) (Check one) <input checked="" type="checkbox"/> The purpose, function, and nonprofit status of this organization and the exempt status for federal income tax purposes. <input type="checkbox"/> Has Not Changed During Preceding 12 Months <input type="checkbox"/> Has Changed During Preceding 12 Months (Publisher must submit explanation of change with this statement)				
13. Publication Title <b>Mobile Radio Technology</b>		14. Issue Date for Circulation Data Below September 1999		
15. Extent and Nature of Circulation		Average No. Copies Each Issue During Preceding 12 Months		No. Copies of Single Issue Published Nearest to Filing Date
a. Total Number of Copies (Net press run)		29,062		27,400
(1) Paid/Requested Outside-County Mail Subscriptions Stated on Form 3541. (Include advertiser's proof and exchange codes)		25,970		25,941
b. Paid and/or Requested Circulation				
(2) Paid in-County Subscriptions (Include advertiser's proof and exchange codes)				
(3) Sales Through Dealers and Carriers, Street Vendors, Counter Sales, and Other Non-USPS Paid Distribution				
(4) Other Classes Mailed Through the USPS				
c. Total Paid and/or Requested Circulation (Sum of 15b. (1), (2), (3), and (4))		25,970		25,941
d. Free Distribution by Mail (Samples, complimentary, and other free)				
(1) Outside-County as Stated on Form 3541		1,306		689
(2) In-County as Stated on Form 3541				
(3) Other Classes Mailed Through the USPS				
e. Free Distribution Outside the Mail (Carriers or other means)		544		300
f. Total Free Distribution (Sum of 15d. and 15e.)		1,850		989
g. Total Distribution (Sum of 15c. and 15f.)		27,820		26,930
h. Copies not Distributed		1,242		470
i. Total (Sum of 15g. and h.)		29,062		27,400
j. Percent Paid and/or Requested Circulation (15c. divided by 15g. times 100)		93.4%		96.3%
16. Publication of Statement of Ownership <input checked="" type="checkbox"/> Publication required. Will be printed in the <b>November 1999</b> issue of this publication. <input type="checkbox"/> Publication not required.				
17. Signature and Title of Editor, Publisher, Business Manager, or Owner <i>Don Bishop</i> EDITORIAL DIRECTOR				Date Sept. 22, 1999
I certify that all information furnished on this form is true and complete. I understand that anyone who furnishes false or misleading information on this form or who omits material or information requested on the form may be subject to criminal sanctions (including fines and imprisonment) and/or civil sanctions (including civil penalties).				



# classified



Reserve your spot in the next issue!

Phone: 913-967-1861

**800-347-9375**

Fax: 913-967-1735

Mail: 9800 Metcalf Ave.,  
Overland Park, KS 66212



Dawn Rhoden  
Classified Advertising  
Manager

## Category Index

Computer Software .....	58
Employment .....	49
Equipment For Sale .....	50
Professional Consulting Services ...	59
Professional Services .....	49
Rentals .....	57
Repair Services .....	58
Services .....	58
Tower Equipment .....	57
Tower Space .....	57

## professional services

### FREDERICK G. GRIFFIN, P.C.



3229 Waterlick Road  
Lynchburg, VA 24502  
(804) 237-2044

NATIONWIDE COMMUNICATIONS CONSULTING  
Mobile Radio, Microwave, E9-1-1,  
CAD, Paging, LAN,  
Dispatch Communications Centers  
Multi Site Propagation Analysis

### HERB SACHS, CONSULTING

*Specialist in Public Safety Communications*

P.O. Box 729  
Bowie, MD 20715  
301-464-4268

### PORTA-TECH

**PORTABLE  
TECHNICAL  
SERVICE, INC.**

121 Crowell Lane • Lynchburg, VA 24502

GE Portable Radio Service Depot  
Factory Approved Nationwide  
FOR QUALITY SERVICE  
• Current Product Lines  
• Voice Guard Certified  
• Public Service Trunking  
• Surface Mount Technology  
**ERICSSON** (804) 239-3049



**OMNICON, Inc.**  
COMMUNICATIONS ENGINEERING

**GENE A. BUZZI**  
PRESIDENT

930 THOMASVILLE ROAD, SUITE 200  
TALLAHASSEE, FLORIDA 32303  
PHONE: (850) 224-4451 • FAX: (850) 224-3059  
E-mail: omnicon@polaris.net



**SCHWANINGER & ASSOCIATES**  
Attorneys at Law

**Robert H. Schwaninger, Jr.**

1835 K STRELL NW, SUITE 650  
WASHINGTON, D.C. 20006  
(202) 224-8337  
rschwaninger@sa-lawyers.net

### MCCON

**Mobile Communications Consulting**  
S.R. McConoughey, P.E.  
Principal

13017 Chestnut Oak Drive  
Gaithersburg, MD 20878 (301) 926-2837

**TROTT**  
COMMUNICATIONS GROUP

**RAYMOND C. TROTT, P.E.**  
Chairman

1425 Greenway Drive, Suite 350  
Irving, Texas 75038  
972/580-1911 • Fax: 972/580-0641

### GE PORTABLE SERVICE

- FAST TURN
- WARRANTY
- \$48.00 hr./2 hr. MAX
- PARTS GE LIST
- RETURN UPS PAID



**Smith Communications Service**

2121 W. Parrish Ave., Owensboro, KY 42301  
270-683-0936

### THE PORTABLE DEPOT, INC.

KEEPING AMERICA COMMUNICATING FROM COAST TO COAST



- FACTORY TRAINED TECHNICIANS •
- SURFACE MOUNT TECHNOLOGY •
- FACTORY APPROVED NATIONWIDE •
- EDACS & AEGIS •
- VOICE GUARD CERTIFIED •

• MPD, MPA, TPX, PCS AND ALL CURRENT PRODUCTS •  
Route 2, Box 338C • Lynchburg VA 24501  
**ERICSSON** 804-237-3427

## employment



### Engineers

Michigan State Police is seeking experienced engineers for the new APCO 25 statewide radio system. These positions are in the Planning and Engineering Section located in Lansing, MI. A Bachelor of Science degree in Engineering and three years of engineering experience is required. Eligible engineers should have at least two years experience in one or more of the following areas: telecommunications system design, trunked radio technology and equipment, hardware/software configurations and upgrades, antenna design, propagation and coverage analysis, voice and data standards, security, traffic analysis, LAN/WAN, fiber optics and microwave networks (see [www.mpscs.com](http://www.mpscs.com)).

Salary range is \$43,240-\$57,590 with excellent benefits. Civil Service application with drug screening is required. EOE

(517) 336-6126  
Anne Phillips - P&E Section Manager  
(517) 336-6222 Fax

### WIRELESS COMMUNICATIONS TECHNICIAN

Field technician—Must be experienced in systems: base stations consoles, microwave and data. PCIA or FCC certification preferred. Resume to:

**Metropolitan Communications, Inc.**  
309 Commerce Drive, Exton, PA 19341  
E-Mail: [mcs@chesco.com](mailto:mcs@chesco.com)  
Fax (610) 524-9970

**Get more exposure from your classified advertising.  
Advertise on the MRT website.**

**mrtmag.com**



**BUY • SELL • TRADE • CLEAN WORKING EQUIPMENT**

**Bases, Repeaters, Paging TX**

3 MSF 5000 C74CXB UHF Repeater 110 Watt	Call
20 MSF 5000 C74CLB UHF Repeater 110 Watt	From \$2000
4 MSR 2000 C73KSB VHF 110 Watt	From \$1495
18 Micor UHF Repeater 20-250 Watt, DVP Available	From \$995
10 Micor 800 MHz 20-125 Watt Repeaters	From \$995
50 Micor VHF 110 Watt Base/Repeaters	From \$995
30 GE 900 MHz Paging Digital or Repeater 60 Watt	Call
20 Mitrek Super Console/Low VHF/UHF	From \$300

**Mobiles 25-50 MHz**

50-Ranger 100 Watt 35-50 MHz 32 Ch	From \$295
150 Mitrek 100 Watt 30-39 MHz 4 Ch	From \$100
80 Mitrek 60 Watt 30-39 & 39-50 MHz 4 Ch	From \$50
400 Masir II 100 Watt 25-30, 39-42, 42-50 MHz 8 Ch	From \$50

**VHF Mobiles 140-175 MHz**

8 Syntor X 9000 110 Watt 32 Ch 145-175 MHz	From \$400
10 Spectra Dash or Rear Mount 30 Watt 128 Ch	From \$395
6 Ranger 50 Watt 32 Ch	From \$250
100 Delta-S N3HH1N110TA, 100 Watt 16-32 Ch	From \$100
100 Syntor X 40-100 watt 32 Ch, Also DVP Models	From \$50
40 Syntor X T3VXJ7204BK 100 Watt DVP w/Mic Control Head	Call
200 Micor 100 Watt 4-12 Ch	From \$50
25 Mitrek 45-100 Watt 1-4 Ch	From \$50
300 Masir II / IIE 100 Watt PLL Exciter Available	From \$50
50 PAC-RT Mobile Repeater 1.5 Watt	From \$50

**Mobiles 450-495 MHz**

10 Spectra 9000 110 Watt 128 Ch	From \$895
50 SyntorX 9000 110 Watt 32 ch, Also DVP Available	From \$395
30 SyntorX 40-110 Watt 32 Ch, Also DVP Available	From \$100
40 Mitrek 30-100 Watt 4 Ch	From \$50
50 Masir II 45-75 Watt, Also E Model w/Duplexer	From \$100
15 Masir II 75 Watt 470-495 MHz	\$360
10 PAC-RT Mobile Repeater 1 Watt & VRS	From \$150

**Mobiles 800-900 MHz**

12 Syntor X 9000, 35 Watt T45KEJ7J04AK	From \$100
20 Spectra 900 T D27KGa5JBSDK	From \$250
25 Johnson 8610A107 & 8710A017	From \$25
70 Maxtrac 80 T B1-B7	From \$50
12 MTX 8000 (B7)	From \$295

**Misc Items**

100 Centracom I & II, II Plus Consoles BIM, CEB, & Paris	Call
10 Spectra Votex, Several Types	Call
5 Secure-Net Ee DVP C69SAF/T5090/T5091	Call
2 Secure-Net Console Interface T5007AK	Call
50 GE 5550 Delta/Ranger Scan Heads	\$200
200 Tons & DC Remote Controls & Adaptor Interface	Call
200 Masir II & Micor Base Station Cards	Call

**BARNETT ELECTRONICS INC.**  
 330 HWY 236 W., Lonoke, AR 72086  
 Orders & Bids: 800-423-3858 FAX: 501-676-2475

For Expanded List, updated weekly, look at our Website: [www.barnettelec.com](http://www.barnettelec.com)

Info: 501-676-5506  
 VISA & MC Accepted, NO COD's

Circle (116) on Fast Fact Card

Will pay **TOP DOLLAR**  
 for Motorola 800MHz Trunked  
 Mobiles & Portables.

**Metro Communications LLC**  
 (423) 546-0311 - Jim Hayes

**TRANSMITTERS**

**900 MHz, VHF & UHF**  
**72 links & receivers**  
**GL - 5353 PA**  
 Call for what you are looking for.

**H-MC&E, Inc.**  
 770-242-8979 Pat Fooks



Your Full Service,  
 VALUE-ADDED Distributor of  
 Communications Products.

Check out our Web specials!  
[www.radiocomm.com](http://www.radiocomm.com)

- Wholesale prices to Dealers Only.
- Self-servicing users welcome.
- We carry a wide selection of both radios and accessories for your convenience.
- We have a Flat Rate Repair service.
- We sell and install MX-COM boards.

800-726-9015 • 612-808-0069  
 fax: 612-808-0087  
 email: [sales@radiocomm.com](mailto:sales@radiocomm.com)

Circle (101) on Fast Fact Card



**Communication Test Equipment**

IFR 500	\$3,000	Motorola R2008C	\$4,500
IFR 1000A	\$2,750	Motorola R2001B/HS	\$4,000
IFR 1000S	\$3,500	Motorola R2002B/HS	\$4,000
IFR 1100S	\$3,900	Marconi 2955/2957	\$2,750
IFR 1500	\$6,500	Marconi 2955B/2957B	\$4,900
Motorola R2008D	\$6,200	Triplett 5000E	\$2,250
Motorola R2009D	\$6,200	Sage 930 T1 Set	\$2,250

EML will buy your used test equipment.

We accept:

**(888) 846-4614 • [www.eml1.com](http://www.eml1.com)**

Circle (118) on Fast Fact Card

**employment**

Immediate opening for a **Portable Technician**  
 in the Knoxville, TN area. Near the Great  
 Smokey Mountains—a hunting and fishing  
 paradise! Must have 5 years experience repairing  
 Motorola and General Electric equipment.  
 Excellent salary & benefits package. Contact  
 Jim Hayes at (423) 546-0311.

**WIRELESS STAFFING SPECIALISTS**

ALL LEVELS OF POSITIONS FILLED GLOBALLY  
 • Technicians • Engineers • Managers • Sales  
 Send resume to address below

Check web page for immediate openings  
[WWW.PERSONNEL1.COM](http://WWW.PERSONNEL1.COM)



**PERSONNEL RESOURCES, INC.**  
 P.O. Box 14570, Cincinnati, OH 45250  
 E-Mail: [Careercom@AOL.com](mailto:Careercom@AOL.com)

Since 1989  
 606-491-5410 FAX 606-491-4340

**ICT**

**TWO WAY RADIOS**

**LOWEST PRICES OF THE UNIVERSE!!**

**Tons in Stock - Same day shipping guaranteed!!**

**SP50 - P110 - GP300 / 350 - P1225 - P200 + GP68**  
**GP88 - SM50 / 120 - M120 - M1225 - GM300**

**7875 N.W. 29th St. - Miami, FL 33122**  
**305.640.2424 - Fax: 305.640.0756**

All models named in this ad are Trademarks of Motorola Inc.

**Visit us at [www.ictwireless.com](http://www.ictwireless.com)**

Circle (103) on Fast Fact Card



# A Passion For Excellence.

**Call Today For Your FREE Catalog!**

[www.antenex.com](http://www.antenex.com)



Antenex is an established leader in the design and manufacture of innovative antenna products. Our latest Antenex Catalog is the perfect reference and buying guide for dealers. It features new products, as well as color photos, graphs, patterns, detailed descriptions and specifications of our full line of antenna products.

**United States:**  
Phone: (800) 323-3757  
Fax: (800) 851-9009

**International:**  
Phone: (630) 351-9007  
Fax: (630) 351-9009

Antenex Inc., 2000-205 Bloomingdale Road • Glendale Heights, Illinois 60139

Circle (104) on Fast Fact Card

## MOTOROLA RADIOS

RADIUS - RADIUS - RADIUS

NOBODY BEATS OUR PRICES—NOBODY BEATS OUR INVENTORY!

SP50 - P110 - GP300 - P1225 - SM50 - M130 - M1225 - GM300

MANY USED/DEMO TRUNKED & CONVENTIONAL RADIOS IN STOCK

HT1000-MARATRACS-SPECTRA-STX-MTX8000-PP1000X-MAXTRAC-MTX800

SALES: 800-545-7748 • FAX: 703-830-8710

VISIT US AT

<http://www.radioexpressinc.com>



Circle (105) on Fast Fact Card

AVL / GPS EQUIPMENT

**MOTOROLA Radius**  
Lowest Prices!

"NEW" PRO 5150/7150/8150

**GP 88 & 68 VHF/UHF**

Most popular models in stock!  
Complete Radius Line!

**KENWOOD**

New and Used  
(some restrictions may apply)

Special State & Local Gov. Discounts

**1-800-264-9516**

**FAX 303-415-1557**

**COMMUNICATIONS WEST, LTD.**

E-Mail: [commwest@aol.com](mailto:commwest@aol.com)

DOMESTIC & EXPORT SALES

**LOWEST PRICES!**

BATTERIES • EXPORT ITEMS • ACCESSORIES

PARTS • TURNKEY SYSTEMS • ANTENNAS

**Now You Can Solve Voter System Problems Fast!**

Remote Comparator Display



Remote Voter Display Screen

- \* Control Your Voters from a Remote PC
- \* Cuts Costly Maintenance Time
- \* Finds Intermittent Problems Fast
- \* Reduces Receiver Downtime
- \* Logs Receiver Failures
- \* Modular & Expandable

Call or Write for our **FREE** System Planner!

**Transmitter Coverage Problems?**

Transmitter Steering Unit



- \* Use with Multiple Transmitters to Extend System Coverage
- \* Automatic Transmitter Selection
- \* Far Lower Cost than Simulcast
- \* Fills Gaps in Existing Coverage
- \* Better than Relay-Based Controllers
- \* Works with Standard Base Stations

**CTI Products Inc.**

Land Mobile Radio Solutions

1211 West Sharon Road, Cincinnati, Ohio 45240

(513) 595-5900

[info@ctiproductions.com](mailto:info@ctiproductions.com)

[www.ctiproductions.com/landmobile](http://www.ctiproductions.com/landmobile)

Circle (106) on Fast Fact Card



## Audio Accessories for 2-Way Radios!

**Klein**  
**electronics**

**(800) 959-2899**

Fax: (760) 631-1163

E-mail: info@kleinelectronics.com

Web: www.kleinelectronics.com

**Call Now!**

K700-  
"Public Safety"



Tactical Headset  
Bike Patrols  
SWAT Teams

K500-  
"Top Seller"



Dual Muff Headset  
for Safety Helmets

K400-  
"Best in Class"



Dual Muff  
Headset w/Noise  
Cancelling Mic

K9725-  
"Easy to Use"



Heavy Duty Remote  
Speaker Mic

K111-  
"Affordable"



2 Pc.  
Lapel Kit

Circle (107) on Fast Fact Card

### TEST EQUIPMENT - BUY & SELL!!

HP8901B Modulation Analyzer-S3400; HP8901A-S990; HP8903B Audio Analyzer-S1800; Anritsu 6420A Data Analyzer-S600  
**SERVICE MONITORS** All include NIST Traceable Calibration  
HP8920A/102/3/4/5/13 ..... \$7900 HP8920B 001/102/4/13-S13.500  
HP8921A/600 (CDMA) ..... \$9900 HP8921A ..... \$8900  
HP8920A/1/3/4/5/13 ..... \$6500 HP89215A ..... \$990  
IFR COM120B (2/12/20) ..... \$9900 IFR 1100S ..... \$3900  
IFR 1600S ..... \$9500 IFR 1200S ..... \$5500  
Wavetek 3600D (IS-136 TDMA) 1.9 Ghz PCS VSELP ..... \$14.500  
Wavetek CAT600 (cellular activation tester) ..... \$550  
Motorola R2600B ..... \$6900 Motorola R2600C ..... \$8500  
Motorola R2001D ..... \$5500 Motorola R2200B ..... \$3600  
Motorola R2012D (Trunk ISB) ..... \$8500 Motorola R2400A ..... \$4500  
Marconi 2955A ..... \$3400 Marconi 2957A ..... \$3500  
Marconi 2957D ..... \$4900 Marconi 2957B ..... \$4700  
Marconi 2955B ..... \$4500  
Witron Schemesters ..... Call Eagle Return Loss Bridges ..... Call

Synth. 1000 Mhz Signal Generators  
Rascal 9087-1300Mhz Signal Generators, low phase noise, high stability,  
AM/FM/Pulse/Phase Modulation, NEW units with warranty!-\$3500;  
HP8657A-S2800; Marconi 2022A-S1800; 2022C-S2000  
**Amtronix Instruments, Inc.**  
Ph: 716-763-9104 • Fax: 716-763-0371  
<http://www.amtronix.com>

### BUY-SELL-TRADE

GE BASE PARTS PRICED TO SELL

Transmitter PA on 450-470, 40W, int. duty  
w/factory brkt ..... \$175  
Drawer unit on 450-470 w/receiver & exciter,  
2C elements and 10 volt reg. .... \$400  
18 amp Power Supply ..... \$50  
10 Volt Regulator Card ..... \$150  
44" Cabinet ..... \$250

**WOLFE**  
**COMMUNICATIONS**

1113 Central Avenue  
Billings, MT 59102  
Phone: 406-252-9220  
Fax: 406-252-9617

<http://members.aol.com/cwwolfe.com>

**COMPLETE CHANNEL ELEMENTS**  
**YOUR FREQUENCY**  
**LIFETIME GUARANTEE**  
**Most Elements \$20.00 With Trade**

Crystals  
We Buy Used Elements

**NKX**

1814 Hancock St.  
Gretna, LA 70053  
504-361-5525 (in LA) • 800-237-6519  
FAX 504-361-5526

**Lots of New Two Way Radios!**

**For immediate delivery**

**... at the very best prices!**

KENWOOD YAESU Verlex ICOM

**Prices Starting at \$59!**

Programming hardware kits \$89.00  
Icom repeater maker kits \$79.00

Free Items in 20+  
Radios Ordered!

Portable, Base & Mobile Antennas: Decibel, Larsen,  
Maxrad, Hustler, Antenex, Cushcraft, ASP and more

Coax Cable: Belden & Helix

Conventional and Switching  
power supplies: Astron & Samlex

R.F. Test Equipment:  
IFR, Bird, Optoelectronics, Ramsey

Connectors, audio accessories, batteries,  
solar modules, R.F. amplifiers, Lightning  
protectors, trunking panel, interconnectors.....

10' tower sections. Prices start at \$33.00

Duplexers Syscom, Decibel, Wacom,  
prices start at \$129.00

**EPCOM**

MIAMI, FL.  
7262 NW, 54 St  
(305) 889-1127 FAX 889-0652  
MIAMI, FL., 33166 U.S.A.  
E-mail: [epcom@bellsouth.net](mailto:epcom@bellsouth.net)

Ask for your  
free Catalog

EL PASO, TX  
1630 PAISANO DR.  
(915) 533-5119 FAX 542-4701  
EL PASO, TX 79901 U.S.A.  
[www.epcom.net](http://www.epcom.net) [epcom@whc.net](mailto:epcom@whc.net)

Circle (108) on Fast Fact Card

**INFONET**  
2000 INC.

Your #1 Source for Pagers,  
Cellulars, Computers & Parts

Tel: (954)227-9779

Fax: (954)227-9757

e-mail: [Infonet@gate.net](mailto:Infonet@gate.net)

Florida ♦ USA

100% Satisfaction  
Guaranteed

**Get more coverage from  
your classified advertising**

**PUT YOUR AD ON THE  
MRT WEBSITE!**

**Details from Dawn Rhoden**  
**1-800-347-9375**





**MIRAGE:**  
The original NMO mount low profile antenna.



**MIRAGE II:**  
Permanent mount "NGP" version of Mirage.

## ANTENNAS THAT WORK

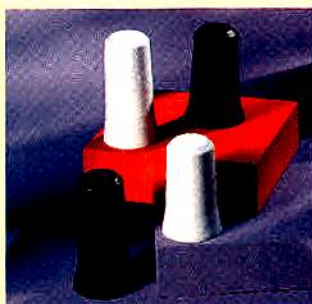
Larsen offers you much more than mere low profile antenna options:

- DESIGN INNOVATIONS
- EXPERT ENGINEERING
- TECHNICAL PRECISION
- MECHANICAL DURABILITY
- REAL WORLD TESTED PERFORMANCE

Call today for a copy of

**THE LARSEN ANTENNA SOURCEBOOK™ '99**  
featuring our complete line of low profile antennas. **1-800-ANTENNA** in the US and **1-800-663-6734** in Canada

VISIT OUR WEB SITE: [www.larsenantennas.com](http://www.larsenantennas.com)  
E-MAIL: [larsen@larsenantennas.com](mailto:larsen@larsenantennas.com)



**SHADOW:**  
Transit style, radome enclosed antenna.



**GPS DUAL BAND:**  
Combines GPS with UHF, SMR, Cellular, Data or PCS frequencies.



Circle (109) on Fast Fact Card

All CCII  
Labels

WHITE, ORANGE, GREEN AND RED  
BUTTONS AVAILABLE

**\$12.50 ea**

CCII PROGRAMING AVAILABLE

ORDERS SHIPPED IN 14 DAYS

**NORTHEASTERN**  
Communications, Inc.  
Waterbury, CT (203) 575-9008

**CALL US FIRST**  
at AIR COMM  
**WHY PAY MORE!**

Used/Reconditioned Motorola, E/GE, EFJ, Kenwood,  
Uniden 2-way radios and accessories  
—ALL FREQUENCY BANDS—  
PLUS

"PL" and paging reeds/filters, TCXOS  
Call us last to sell any of the above.

**AIR COMM**  
4614 E. McDowell Rd. Ph.: 602-275-4505  
Phoenix, AZ 85008 Fax: 602-275-4555

**GP-68 GP88**  
**GP-300**

**SPECIAL PRICES and in STOCK!**  
Keypad programmable GP-68  
UHF 430-470 MHz  
VHF 136-174 MHz

**Features:**  
PL/DPL built-in  
9 DTMF memories  
Auto or Programmable  
Repeater Offset  
1 or 5W Power level  
All GP-68 radios include:  
3 hour rapid charger  
1200mAh battery

E-mail: [info@nsiradio.com](mailto:info@nsiradio.com)  
<http://www.nsiradio.com>



**NSI Communications**

Tel: (253) 946-2426  
Fax: (253) 946-8311

GP-68, GP-300, GP-88 trademarks of Motorola Inc.



GP-68

(540) 891-0569 We accept VISA and MasterCard Fax: (540) 891-0538

**MECHEM ELECTRONICS**

Massaponax Business Park  
3605 Loren Whitney Drive  
Fredericksburg, VA 22408  
Mailing Address:  
P.O. Box 7846  
Fredericksburg, VA 22404

- ▶ Two-Way Radio Communications
- ▶ New and Reconditioned Radios
- ▶ Custom-Designed Radio Systems
- ▶ Repair and Programming
- ▶ Consulting

Hi-power/Low-band PL Mitreks 29.7-38.9MHz  
Saber I, UHF, DES hi-power (rack & indiv. chrgs, etc.)  
Mid-band bases secure

Console interface units  
Secure modems  
Secure spectratrac receivers  
Digitac comparators  
Centracom II CEB cards, cont. panels & complete  
GCC80 complete (MDC-1200 & MDC-600)  
MSF 5000 VHF Secure repeaters  
400W 150.8-162 & 162-174 rpters.- paging & secure  
250W 450-470 repeaters. - clear & secure

URL Address: <http://www.mechemelectronics.com>

E-Mail: [mechem@fls.inf.net](mailto:mechem@fls.inf.net)

Circle (110) on Fast Fact Card

**MRT**  
Advertising  
that Works  
**Classifieds**



**DOES YOUR ADVERTISING  
WALK AND TALK?**

**IF  
NOT GIVE  
THE LABEL EXPERTS  
A CALL !!**

**Anchor  
Graphics  
Marketing, Inc.**  
"The Label Experts"  
972-242-0439 FAX 972-242-0959  
1-800-875-7859



**CHANNEL ELEMENTS  
YOUR FREQ. - \$20.00**

with trade-in/3 working days

**CRYSTALS**

MAXON, TEKK, UNIDEN/7 working days

Channel Element HQ/Kirby Ent.  
4120 Kirby Rd. Cincinnati, OH 45223

**1-800-237-9654**  
FAX: 513/542-8870

**Simulcast  
SOLUTIONS**

716.223.4927 TEL  
716.223.3255 FAX

[www.simulcastsolutions.com](http://www.simulcastsolutions.com)



**On-frequency Repeater**

Circle (112) on Fast Fact Card

## Universal Rapid Charger + Conditioner & Battery Packs

### ► MH-C888 Universal Drop-in Rapid Charger + Conditioner

- Support NiCD & NiMH 4.8 - 12V
- Universal Drop-in design for hundreds of radios.
- PowerShare features allow hassle-free charger banking, up to 12 units.
- 1 & 3 cycle conditioning mode.
- FLEX pulse charge.
- Built-in switching power supply.



### ► Battery Packs

Hundreds of NiMH and NiCD rechargeable battery packs available for Motorola, Kenwood, Icom, Vertex, Standard two-way radios.



**MAHA**

"Your Supplier, Your Partner,  
Your Friend!"

Tel: 1-800-376-9992 or 714-985-9132 Fax: 714-985-9221  
2841-B Saturn St. Brea, CA 92821

<http://www.maha-comm.com/>

Circle (111) on Fast Fact Card

## FOR SALE H-P-8920-A

**RADIO SERVICE MONITORS  
QUANTITY (17) FOR SALE  
WITH OPTIONS**

- (5) H-P-8920-A OPTIONS 2/3/4/5/13/14/50 ... \$8900
- (6) H-P-8920-A OPTIONS 2/3/4/5 ... \$8500
- (6) H-P-8920-A OPTIONS 1/2/3/4/5/10 ... \$8900



**ASKING  
\$8,500**

- 500KHZ to 1GHZ Frequency Range
- Spectrum Analyzer w/Tracking Generator
- Duplex Generator/Digital/Analog Signaling
- LTR/EDACKS/MPT-1327 Trunking Test
- High Stability OCXO
- 8 Month Warranty & 10-day Right of Refusal
- Tested and Calibrated

USED TEST EQUIPMENT WANTED,  
FAX YOUR LIST TO +1 925-229-2035

**RF IMAGING & COMMUNICATIONS**

+1 925-229-2034 • FAX: +1 925-229-2035

<http://www.best.com/~rfimage>

E-MAIL: [rfimage@best.com](mailto:rfimage@best.com)



Circle (113) on Fast Fact Card

**Don't let  
time catch  
up with  
you!**

**Get your  
ad in today!**

**800-347-9375**

## LABELS • LABELS • LABELS

Custom Made Labels for Pagers, Cell Phones & Two-Way Radios

Distinctive Foils & Holographic Materials

Tamper-Proof Warranty Labels

Screen-Printed Labels, Signs, Overlays

Motorola Certified Pager Repair Labels

Bar Code Thermal Transfer Printing Systems

**ADVANCE LABEL & TAG**

**1-800-466-5345**

**972-542-5345**

**Fax: 972-2518**

**www.altag.com**

**WE  
BUY  
AND SELL  
USED  
MOTOROLA,  
GE AND  
ERICSSON  
FM  
TWO-WAY  
RADIOS**

**SCHAEFER  
RADIO CO.**

130 West  
Fayette St.,  
P.O. Box 395  
Denver, IA  
50622

PHONE:

(319)

984-6115

FAX:

(319)

984-6220

- 11 ea. PURC 5000 Bases, 900 MHz, C85JL1101A
- 8 ea. MICOR PURC Bases, 900 MHz, C75J2B1101A
- 1 ea. SMARTNET Trunking Controller, T5076A
- 3 ea. MICOR Rptrs, 800 MHz, C65RCB5103AT
- 1 ea. TXRX 5 CHANNEL COMBINER
- 9 ea. GTX, 800 MHz, H11UCD6C81AN
- 5 ea. GTX, 800 MHz, H11UCD6C81AN
- 6 ea. SPECTRA, 800 MHz, D45KMA7JA7AK
- 81 ea. SPECTRA, 460 MHz, D44KMA7JA5BK
- 1 ea. MICOR Comm. Rptr, 460 MHz, C64RCB3105AY
- 6 ea. MICOR Bases, 460 MHz, C64RCB1105AT
- 71 ea. SYNTOR X 9000, 460 MHz, T34KEJ7J04AK
- 77 ea. SYNTOR, 460 MHz, T44SA3200
- 2 ea. MCX 100, 460 MHz, M13M24PSA7D00BK
- 9 ea. RADIUS, 460 MHz, H34GNL6120
- 13 ea. GE MLS, 460 MHz, MLSU240
- 41 ea. PAC RT, 460 MHz, H14TTY3110A
- 13 ea. RADIUS P110, 460 MHz, P94QLC20A2AA
- 6 ea. MTS2000, 460 MHz, H01RD09PW1BN
- 1 ea. MSR2000 Base, 155 MHz, C73KSB3106B
- 9 ea. SPECTRA, 155 MHz, D43KXA7JA5BK
- 99 ea. SYNTOR, 155 MHz, T83SA3D00AK
- 7 ea. MITREK, 155 MHz, T83JA3000
- 40 ea. PAC RT, 155 MHz, H13TTY3110A
- 30 ea. MARATAC, 48 MHz, T81XTA7DA3AK
- 99 ea. MITREK, 48 MHz, T81JA4000
- 10 ea. MICOR Bases, 37 MHz, C71RTB1406
- 39 ea. MARATAC, 37 MHz, T81XTA7JA5BK
- 99 ea. MITREK, 35 MHz, T81JA4000K
- 2 ea. MT1000, 33 MHz, H41GCU7160
- 10 ea. MINITOR II, 33 MHz, H01UMC1222
- 100 ea. Motorola SYSTEMS 90 Sirens
- 1 ea. Lot MC 400 MUX

WANTED: RADIUS Mobiles, Portables, & UHF SYNTORS



3 - NEW  
Radio Cables  
19, 20 & 21

## Radio Programming Cables

Model #s	The Motorola® Radio It Programs	Price
1	HT50 and the Radius P100 Models	\$59. <sup>95</sup>
2	HT600, MT800, MT1000, P200, P500, MTX800, MTX810, MTX820, MTX900. (connection on top of radio)	\$85. <sup>95</sup>
3	MARATAC, (MAXTRAC - 50, 100, 300, 820, 840, M860), M1225. (RADIUS - M100, M206, M208, M214, M216, M400, GM300), SM10, SM50.	\$59. <sup>95</sup>
4	STX, STX Gemini, STX 821 trunked portables.	\$79. <sup>95</sup>
5	SABER and System SABER.	\$99. <sup>95</sup>
6A	SPECTRA Low and Medium Power Units.	\$79. <sup>95</sup>
6B	SPECTRA 100 Watt and High Power Units.	\$79. <sup>95</sup>
7	SYNTOR 9000 and 9000E Radio Line.	\$149. <sup>95</sup>
8	Radius P 50 Plus.	\$95. <sup>95</sup>
9	R100 Repeater.	\$49. <sup>95</sup>
10	MCX1000.	\$65. <sup>95</sup>
11	Cloning Cable for the Motorola® HT600 / MT1000.	\$79. <sup>95</sup>
12A	GP300, GP350, and P110 Models.	\$149. <sup>95</sup>
13	MSF5000 Digital Unit with 3 Digit Display in Controller Tray.	\$75. <sup>95</sup>
14	HT1000, MT2000, MTX 838, MTX 8000, MTX 9000 (connection on side of radio) and JEDI Series.	\$135. <sup>95</sup>
15	Visar Unit.	\$119. <sup>95</sup>
16	Cloning Cable for the Motorola® JEDI Series.	\$129. <sup>95</sup>
17	ASTRO SABER and SABER SI.	\$99. <sup>95</sup>
18	SP50.	\$99. <sup>95</sup>
19	M1225.	\$59. <sup>95</sup>
20	P1225.	\$119. <sup>95</sup>
21	HT750, HT1250.	\$79. <sup>95</sup>



## Compatible Motorola® Radio Programmers

### PA-I Programming Adaptor...\$139.95

- Compatible with "RIB" unit.
- Rugged steel case.
- Power LED.

### PA-II Programming Adaptor...\$159.95

- Contains rechargeable Ni-CAD Batteries:
- Perfect for field use and Portable, Laptop & Notebook Computers.
- Status LEDs: Power On and Charge.
- Power Switch.
- Power / Charger Included.
- Runs for 8 continuous hours, from a full charge.



### PA-III Pocket Programmer...\$189.95

- Micro-Size Design for Convenient Portability and Field Use.
- Uses Surface Mount Technology.
- Rechargeable ---- Works hours on one charge.



NOTE: Hardware Only. Software sold by Motorola and other products are trademarks of Motorola, Inc.



Polaris Industries Inc.  
470 Armour Dr. NE • Atlanta GA 30324  
FAX 404.872.1038

# 1-800-752-3571

**Polaris Industries**  
Tech info: 404.872.0722  
www.polarisradio.com

**Compare These Important Points, Before You Buy!**

- Same Day Shipping, When Ordered before 1pm EST.
- We Accept: American Express, Discover, MasterCard and Visa.
- Professional Users Guide with Detailed Photos Included with All Radio Products.
- Compare Polaris' Features and Quality, Don't Accept Imitations!

Circle (114) on Fast Fact Card

## PRE-OWNED RADIOS!

We currently have a selection of pre-owned radios, as well as chargers and accessories. Call for more information and great prices!

UHF	Qty.	MT2000 168 Channel	4
P110 2 Channel	16	Visar 16 Channel	14
P110 4 Channel	14	<b>VHF</b>	<b>Qty.</b>
P110 6 Channel	21	P110 6 Channel	14
SP50 2 Channel	1	SP50 2 Channel	22
SP50 6 Channel	5	SP50 10 Channel	3
P200 6 Channel	97	P200 6 Channel	24
GP300 16 Channel	140	GP300 2 Channel	4
GP350 16 Channel	87	GP350 16 Channel	9
P1225 16 Channel	15	P1225 16 Channel	2
HT1000 16 Channel	6	Visar 16 Channel	14
MT1000 100 Channel	2	All radios include a 30-day warranty.	

Open 7 Days 8am-8pm  
Call to place your order or to request a FREE catalog!  
**1.800.272.7111**  
www.racingelectronics.com



## TRINITY RADIO USED RADIOS at Low Prices!

- MICOR
- MITREK
- PORTABLES
- MOCOM 70
- MAXAR
- RPTRS
- GE
- RCA
- ACCESSORIES
- TONE ELEMENTS
- CHRYSTAL ELEM.
- BASE STATIONS

(940) 433-5452 • trinity-radio.com

## Buy & Sell

Motorola, Uniden, E.F. Johnson, Kenwood  
Two-Way Radios and Systems



**DELTA COMMUNICATIONS**

1-800-880-2250  
FAX: 972-278-5085  
Garland, TX

http://www.delta-twoway.com

## BUYING ERICSSON-GE EQUIPMENT

FLAT RATE REPAIR S-990 & S-950	60
ASTRON R12A Black P.S. NEW	50
MPD 800 mhz if decks, NEW	100
MASTR CONTROLLERS	100
RCN 1000 REMOTES	135
IDN Control shelf, new from	200
VHF MASTR II Station from	1200
UHF MASTR II Station from	2200
Delta/Rangr Station from	450
S990 128 ch head w/warranty	125
S600 4 ch control head	50
S600 Delta/Rangr Accessories	150
S600 control head	50
S550 control head non scan	65
S500 control head	65
Phoenix-SX 16Ch VHF w/acc	150
Phoenix-SX UHF w/acc	165
MLSH040 VHF MLS w/acc	250
MLS 35-42 & 42-50 w/acc	250
MVS 150-174 w/acc	250
TMX-8615/8630 less acc	75
KPC 300 Ericsson VHF Port.	225
KPC 300 Ericsson UHF Port.	235
MPA VHF/UHF Portables	Call
MPA/MPD Std. rate chargers	42
MPI 8 unit multi-charger	40
Rangr 35-42 less acc. 60W	225
Rangr 30-42 less acc. 100W	325
Delta-S 450-470 less acc. 100W	225
Delta-SX 150-174 less acc. 100W	250
Delta-S 42-50 less acc. 110W	135
Delta-S 42-50 less acc. 60/w	100
MASTR II 150-174 110W less acc	125

**NEW LONDON TECHNOLOGY**  
752 Alum Springs Road • Forest, VA 2455  
Tel: 804-525-0068 • Fax: 804-525-0078  
www.newlondontech.com

Check us out on the Web! [www.mrtmag.com](http://www.mrtmag.com)

In Business Since 1968

**M J Communications, Inc**  
Call us Toll Free at 877-945-9307

**ALL MAJOR BRANDS**  
New and Used Equipment  
See our Web Site @ [www.mjcomm.com](http://www.mjcomm.com)

We accept Visa and Mastercard  
We buy Used Equipment, Fax us your list  
Special Pricing on FRS Radios

Fax# 501-945-0333

4228 East 43rd  
North Little Rock, AR 72117

501-945-9307  
501-945-3331

Circle (115) on Fast Fact Card

## SAVE BIG BUCKS ON Used 2 Way Radio

MOTOROLA • GE • EF JOHNSON etc.  
PORTABLES / PAGERS / MOBILES / BASES / REPEATERS

Contact us when you are looking for economical used equipment. We are a reliable source for all major brands of used 2 way gear

**(708) 681-0300**

Buy • Sell • Trade

Visit our web site: [WWW.MDMRADIO.COM](http://WWW.MDMRADIO.COM)  
or E-Mail us at [mdmradio@earthlink.net](mailto:mdmradio@earthlink.net)

**MDM Radio Ltd.**

1629 N. 31st Ave. Melrose Park, IL 60160  
Tel. (708) 681-0300 Fax (708) 681-9800



CMC ENTERPRISES 2-WAY, MICROWAVE & TELECOM EQPT.		
Quantity	Equipment List	Price
5000	Andrew 1-58" LDF-50 Helax (NEW)	\$6,000 ea.
15	Farion PAS-600E HOT stubby 60Hz radios (per terminal)	\$3500 ea.
40	Rockwell Collins MP6-2 HOT stubby 60Hz (per terminal)	\$2000 ea.
50	Motorola Starplex Channel Modems MLN6287	\$200 ea.
30	Motorola Maratrac 30-36 110w w/acc	\$325 ea.
05	Motorola MSF 5000 UHF Rptrs 100w chip program	\$2800 ea.
05	Motorola MR-600 Non-standby log radios 60Hz 300ch	\$1000 ea.
40	Motorola Mitrak 30-39 PL (SYS-90 Acc) 110w	\$175 ea.
50	Motorola Starplex Term Cards MLN6288	\$80 ea.
03	Motorola Comparators, signal to noise type	\$400 ea.
14	Kenwood 601-S 16ch 42-50 mobiles	\$150 ea.
05	Centracom II Consoles, less CEB	\$500 ea.
10	Motorola MR-600 non-standby 60Hz 300ch	\$1500 ea.
05	Farion PAS-600E non-standby log radios 60Hz 300ch	\$2000 ea.
08	Farion LR1-2 Hot-standby 2.1-2.3GHz 48ch	\$1500 ea.
08	Motorola Starpoint 2.1-2.3GHz radios w/Hot-standby	\$1800 ea.
12	Motorola Maratrac A2 UHF 110w w/acc	\$375 ea.
12	Raton R 1-660Hz radios w/Hot-standby, Very Good condn	\$2000 ea.
15	Motorola Syntor X 9000 UHF 110w w/acc	\$400 ea.
01	Scientific Atlanta 4653a BERTS Transmitter (DS1/C2)	\$1000

**New Listing** Call Charles at 336-769-2885  
For more equipment, visit our website at [www.cmcent.com](http://www.cmcent.com)

N.H. COMMUNICATIONS CO.	
MOT MSR 2000 UHF 450-470 MHz Model C7465B-6146	\$1,550
MOT Maxar mobiles, VHF or UHF	\$85 ea.
MOT Radio Test Set, Model R-1033 A	\$450
MOT Maratrac low band mobiles 100w 42-50mc w/acc. PL	\$395 ea.
MOT Mostar UHF mobile w/accessories	\$165
MOT Syntor 110w VHF mobile, 4 freq scan w/ accessories	\$170
MOT MaxTrac 300 UHF 6 freq 40w mobiles	\$300 ea.
MOT MaxTrac 300 UHF 16 freq scan mobile	\$395
MOT Mitrak low band mobiles 100w 40-50mc w/acc, PL	\$195 ea.
MOT Mitrak mobiles VHF 110w, w/acc, PL	\$195 ea.
MOT Mitrak low band mobiles, 30-40mc, 60w, w/acc, PL	\$160 ea.
MOT Mitrak VHF 50w base station, local/remote control	\$595
MOT Mitrak UHF 50w base station, local/remote control	\$595
MOT Mitrak 60w 30 to 40mc base station, local/remote control	\$695
<b>RARE FIND Motorola Micor 100w UHF mobile on 408mc</b>	
Model T74RXA3903AA	\$275
MOT Micor mobiles, 100w, UHF, w/accessories	\$175 ea.
MOT Micor 100w mobiles, 42-50mc, w/acc	\$160 ea.
MOT Micor 800mc base station, local and remote control	\$200
MOT Micor mobiles, 42 to 50mc, drawer units, 100w	\$95 ea.
MOT Pak Rat repeaters VHF	\$135 ea.
MOT Mocom 70 UHF base, PL, dash mko	\$195
MOT Mocom 70w mobile, 30-36, PL w/accessories	\$225
MOT MT500 portables, 42 to 50mc	\$90 ea.
MOT MT500 portables, VHF	\$90 ea.
MOT HT90 portables UHF or VHF	\$90 ea.
MOT T138 remotes	\$110 ea.
MOT T1600 remotes DC	\$95 ea.
MOT T1600 4 freq tone remotes	\$185 ea.
GE Mastr II 110w UHF repeater, continuous duty	\$1,995
GE Mastr II 100w mobiles, 42 to 50mc w/accessories	\$185 ea.
GE Mastr II 42 to 50mc mobiles	\$95 ea.
GE Mastr II 100w VHF continuous duty repeater	\$1,995
GE Mastr II 100 watt continuous duty repeater amplifier	
450 to 470 mc, P/N PL19D42489G532	\$1,250
GE Mastr II 110 watt continuous duty repeater amplifier	
150.8 to 174mc, P/N PL19D424786G7	\$800
GE Mastr II 40 watt continuous duty repeater amplifier	
150.8 to 174mc, P/N PL19D424786G5	\$250
GE Mastr II 100w base stations	\$1,595 ea.
GE Mastr II 35 Amp power supplies	\$350 ea.
GE MPI Portables UHF or VHF	\$95 ea.
GE Delta 100w 42-50mc w/acc	\$195 ea.
GE Rangr mobiles 35-50mc, 60w, w/acc	\$285 ea.
GE Rangr 110w mobiles, 29 to 42mc w/accessories	\$475 ea.
GE Executive II 60w, lowband base station, wall mount,	
30 to 36mc, channel guard, DC remote	\$350
GE Executive II UHF base station	\$295
GE Executive II VHF base station	\$175
GE Executive II 60w low band base, wall mount, 30-36, CG	
Channel guard DC Remote	\$395
GE Executive II 100w 8 freq mobile, 42 to 50mc w/accessories	\$175
GE Executive II 100w VHF mobiles with accessories	\$170 ea.
GE Mastr II 100w UHF mobile	\$400
GE Motorcycle radio UHF	\$110
GE S550 Scan Head	\$200
GE 800mc mobile w/accessories, Comb TMX8875	\$145
GE 800mc Radio Programmer	\$175
<b>NEW GE Phoenix SX UHF mobile w/acc</b>	\$285 ea.
GE Phoenix SX VHF mobile w/acc	\$290
GE Custom MPV 35 watt, UHF mobiles w/mic & spkr	\$195 ea.
GE Custom MPV 42 to 50mc mobile w/spkr mko	\$150
Kenwood TK830 75w, UHF, 32 freq, scan mobile	\$395
<b>NEW Kenwood TK850HK 35w, UHF mobiles, 32 chan scan</b>	\$410 ea.
Kenwood TK805D UHF 16 freq scan mobile	\$235
Kenwood TK801S UHF mobile w/accessories	\$145
Midland UHF mobile, Mod. 70-526BL	\$145
Bird Coaxial Resistor Model B135	\$135
Collwave mobile duplexer, GE No. 19C51268P3, 800mc	\$125
Uniden programmer, Model AMX500C	\$795

**WANTED TO BUY: GE Ericsson or Motorola Equipment**  
**N.H. COMMUNICATIONS CO.**  
P.O. Box 5342  
Manchester, NH 03108-5342  
**Tel: 603-668-3004**

Circle (100) on Fast Fact Card

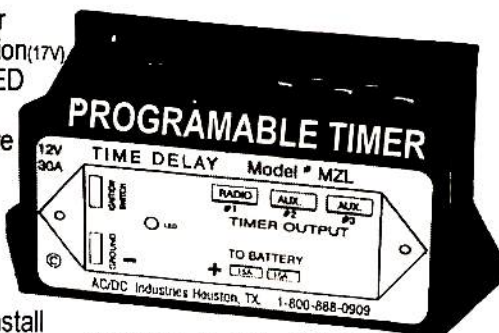
# Delay Timer

Protects The Battery & Radio Equipment

*"On when ignition is off"*

1. Battery Guard - Low Voltage Shuts Down Load
2. Maintains Power to Accessories

- Low Voltage Detector
- High Voltage Protection (17V)
- Built-In Diagnostic LED
- 30 AMP 12 Volt DC
- Sealed From Moisture & Vibration
- Reliable & Accurate
- Allows Retrieval of Incoming Messages
- Intrinsically Safe
- Compact - Easy to Install
- Low Cost - from \$49.00



(800) 888-0909

## AC/DC INDUSTRIES

P.O. BOX 710548, HOUSTON, TEXAS 77271  
Tel: (281) 933-0909 • Fax: (281) 933-1001

Circle (117) on Fast Fact Card

**• BOARDS • STRIPS • ACCESSORIES • ELEMENTS • REEDS •**

**PCI — PEKAAR COMMUNICATION INC.**  
*Steve's back, formerly of Gregory Electronics Corp.*

**\$ Specials of the month \$**

MOTOROLA Mitrak Tabletop base model L-51 JJA 60 watt, low band 36-50 range	\$150
GE Model TMX8415 800MHz Trunking Mobile	\$85
MOTOROLA Syntor mobiles 450-470 Range 100w, T64SRA, T74SRA, T74VBJ, as is, less/acc.	\$150
MOTOROLA maxtrac 800 Trunking Mobiles, D35MQA5GB5BK, less accessories, 2-system, as is	\$39
GE DELTA S Mobile—110w, high band, 150-170 range w/accessories	\$200
GE MLS mobiles high band, with mic & bracket	\$165
GE MPA Portable 16ch high band with antenna & battery	\$200
MastrPro 100w Highband Base, Complete As-is	\$75
GE PHOENIX Mobile NSHH1W40TB—high band dual priority scan/grey case with accessories	\$200 ea.
GE PCS Portable 470-490 range w/battery & antenna	\$175
GE portable model MPR or MPX UHF or high band, AS-IS	\$10
GE CMX 8530 mobiles 800 MHz range w/accessories	\$65
Ericsson GE MDS mobiles comb. TL800, 800MHz range w/accessories	\$98

**Catalog Available...If you can't find it, try us! Call (973) 772-0704 or fax (973) 340-1902**

**• REEDS • ELEMENTS • ACCESSORIES • STRIPS • BOARDS •**

**• BUY • SELL • TRADE •**

## FALL SPECIAL ON MOTOROLA 2-WAY RADIOS

All radios are **BRAND NEW** and come with **factory warranty** and **genuine Motorola Accessories**.

• HT1000, UHF, 16Ch. Under \$500  
(While supplies last)

• SP50, VHF & UHF Under \$350  
• Portables, Mobiles, Trunking

**Payments:** COD or Terms-On approved credit.

**Delivery:** Within 8 business days.

• Accessories:

**HNN9008 \$40**  
HT750/HT1250 Battery w/ belt clip  
(minimum qty of 100pc.)



**AMI**  
(applied micrologic, Inc.)

Sales: 800-410-3669  
Fax: 817-568-8023

Circle (102) on Fast Fact Card

## MB BASE TRANSCEIVER

**MENTOR**  
RADIO COMPANY



• 118.000-135.975 MHz • 10 Watt Output • Performance Monitors • Options — 1-6 Channels, Remote Operation, Rack Mounting • Other Civil Aeronautical Radios • Mobile • Radio Light Control • Nav Signal Monitor/Alert •



**AIRPORT MOBILE COMMUNICATIONS**

**MENTOR**  
RADIO COMPANY

One Channel Standard  
Up To 6 Channels Optional

• 1561 LOST NATION ROAD • WILLOUGHBY, OHIO 44094 U.S.A. • Phone (440) 942-2025 • Fax (440) 942-9129 •



## DEALERS WANTED

Now you can be a dealer in a new line of  
**MOTOROLA 2-WAY RADIOS**

### WETEC ELECTRONICS

**AUTHORIZED MOTOROLA TS-11 DISTRIBUTOR**

**Call Now 1-888-GO-WETEC, ext. 11**

Visit our website at: [www.wetec.com](http://www.wetec.com)

## World's First Talking 32 Channel Radio **SUPER BUYS**

- Motorola 450 MHz LTR, NEW  
List \$580 ea., Dealer cost \$350 ea.  
Your Cost ..... \$300 ea.  
—Limited Time Offer—
- GTX 800 MHz Mobile ..... \$199
- MTX 8000's – B3's portable .... \$199 ea.

Circle (120) on Fast Fact Card

## SABERS - SYNTOR X

- MOT Saber 1E, H44SAG7139CN, UHF, 5 Watts,  
24 Freq., excellent cond'n, w/batt, antenna ..... \$285 ea.
- MOT Syntor X, VHF, 110 Watts, 32 freq., DES, w/hand-  
held control head, all controls in mic, T83VXJDD4AK,  
with EE Prom, complete, excellent cond'n ..... \$325 ea.

**Personalized Service.  
Best Prices Guaranteed!**

**Railcom** Call 901-755-1514 **Motorola**  
Box 38881 **Radius**  
Germantown, TN 38183

**BUY & SELL:**  
**LTR-800MHz & 900MHz** EF Johnson • Kenwood • Uniden  
**MOTOROLA**

UHF • VHF • 800MHz • 900MHz  
• Mobiles • Portables • Repeaters • Amplifiers • Paging Transmitters

**STERLING**  
ASSOCIATES, INC.  
National Purchasing and Sales of Used  
Two-Way Radio Equipment

**1-800-786-2199**  
203 N. Chestnut Street • McKinney, TX 75069  
Fax: 972-562-7957  
Mike Malone  
[www.usedtwoway.com](http://www.usedtwoway.com)



## rentals

**MOSS MOTOROLA  
RADIO  
RENTALS**

Ten years of great  
service to you!

Call for a quote.  
We'll make your next  
project affordable.

*Jason Moss*

[www.mosscom.com](http://www.mosscom.com)  
800-822-MOSS

## MOTOROLA RADIO RENTALS

- HT1000, GP300, P200
- Intrinsically Safe
- Full Line of Radio Accessories
- Mobiles & Repeaters
- 24-Hour Service
- Dealer Inquiries Invited

**1-800-283-COMM**  
EVENT RENTAL COMM., INC.  
e-mail: [eventcomm@aol.com](mailto:eventcomm@aol.com)



## DANGER!

If you aren't advertising in  
**MRT CLASSIFIEDS**,  
you're swimming in  
dangerous waters!

**Call 1-800-347-9375 for help!**

## tower space



**CHECK THE FACTS THEN  
CALL THE BEST!**  
**CHICAGO TOWER LEASING CORP.**

Environmentally controlled  
equipment enclosures, back-up power,  
RF engineered sites. Secure.

Premiere sites in Metro Chicago Area—choice of  
Federal State, Govt. & all Class A Systems.

STAN STANN  
105 MURPHY LAKE ROAD  
PARK RIDGE, IL 60068

**(847) 823-7713**

## ARIZONA'S PREMIER TOWER FACILITIES

Contact Rick or Charlie Bonifasi  
**ANTENNA SITES, INC.**  
**800-346-7224**

## tower equipment

## PageTek

The Monitoring and Control Experts

Monitoring commercial, industrial, and  
government sites worldwide since 1987.

- Monitor and control  
remote equipment via  
modem or phone.
- Receive notifications  
via modem or pager.
- Fully satisfy regula-  
tory requirements.



System leasing plans are now available!  
Contact us now for further details.

Toll-free: 888.572.7907  
Telephone: 919.518.1828  
Fascimile: 919.846.5586  
email: [sales@pagetek.net](mailto:sales@pagetek.net)  
<http://www.pagetek.net>

Circle (122) on Fast Fact Card



# FIXED QUICK, NOT A QUICK FIX.

Your customers demand speed and precision and you should too. **CRI's Service Management System** is designed specifically to track all aspects critical to the successful management of your two-way repair facility. Fast. Easy. Flexible. Call CRI today.

205/987.1523  
email:  
info@crinc.com



Circle (123) on Fast Fact Card

## The Solution for Business Information



### Computer Based Record Keeping

Inventories • Expenses • Billing • Sales

- Record keeping customized for your business -
- www and custom interfaces -

CALL FOR A FREE CONSULTATION

Phone: (913)707-4945 E-mail: jknupp@mid-west.net

## \*\* WIRELESS SOFTWARE \*\*

Save time designing, optimizing and managing wireless radio communication sites:

- Intermodulation Interference Analysis
- Transmitter Noise Analysis
- Receiver Desense Analysis
- Signal Level Analysis
- Communications Site Design
- Site Management Database
- Equipment Maintenance and Inventory
- Desktop Mapping and Data Products

# COMSITE™

CALL 800-845-0408 or 850-906-0748  
http://www.polaris.net/~douglas



## The worst mistakes are the ones you can't see.

Global Trunking Management  
& Billing Solutions for...

SmartNet ♦ SmartWorks ♦ SmartZone  
LTR ♦ MPT 1327

For more information,  
call (903) 561-6673 or  
www.GenesisWorld.com



Circle (124) on Fast Fact Card

## repair services

**MOTOROLA** \$49 Flat Rate Plus Parts  
PORTABLE & MOBILE REPAIR

- Quick Turn Around • Free Return Shipping
- Factory Trained & FCC Licensed Techs



**800-567-5636**  
www.laker.net/arcom

11110 W Oakland Park Blvd, Suite 275, Sunrise, FL 33351

## services

### RF • CELLutions

1100 E. 64<sup>th</sup>  
Denver, CO 80229  
Phone: 303-227-3210  
Fax: 303-227-3220

Complete site Engineering and Design, Consulting, site Optimization, Expansion, site Management, site Maintenance, site Acquisitions and Technical assistance.

We can provide all your RF Communications needs, from Engineering to site construction.

Ask RF • CELLutions about the multi-carrier power cell, (MPC) Re-Radiator, best way to extend your communications sites.

Contact RF • CELLutions  
We can answer all your questions.

### STUDY LAND MOBILE COMMUNICATIONS AT HOME!

38 Lessons written exclusively for Mobile Communications Servicing. \$375.00  
Call, e-mail or write Mobile Training Institute for free information:



2111 Lakeridge Drive  
Grapevine, TX 76051-4614  
817-488-2796 or mtimti@aol.com

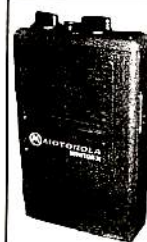
### UHF & VHF TRUNKING

- Frequency Searches
- Licensing • Propagation Studies • Interference Studies
- Short-Spacing Studies • Public Safety & NPSPAC

**1-800-789-5986**

**PALCO**  
ENTERPRISES, INC.

mhastings@palco.net



Minitor II Pager  
Repair Just \$32.50  
Price includes all  
Parts and Labor

**5 Day turn time  
90 Day Warranty**

Water/Physical damage and housing parts not included



**800-822-2180**  
Fax: 561-683-0059

1300 N FL Mango Rd #26  
West Palm Beach, FL 33409 Dealer price

### IT IS POSSIBLE!!!

...to receive quick, quality, service at affordable rates.  
**ADVANCED COMMUNICATIONS  
& ELECTRONICS INC.**

Service of:

- Radios
- Transmitter Amplifiers
- Tower Top Amplifiers
- EDACS Equipment
- Custom Projects
- Equipment Modifications

78 Airport Drive Phone/Fax (804) 237-8255  
Lynchburg, VA 24502-3757 Toll Free: 1-800-488-7908  
E-Mail: advcomm@worldnet.att.net



## Find Solutions

**To Your RF Coverage and Site Management Problems...  
On your own PC!**

For either microwave links or area coverage, our Terrain Analysis Package (TAP)<sup>TM</sup> software helps you find system design solutions in-house.



See details and download demo from our web site!

**SOFTWRIGHT, LLC**  
1010 So. JOLIET ST., SUITE 204  
AURORA, CO 80012-3150 USA  
TEL: (303) 344-5486 • FAX: (303) 344-2811  
www.softwright.com  
e-mail: sales@softwright.com

Circle (125) on Fast Fact Card

## repair services

### Cushman / IFR / Motorola / Wavetek

Get Your Test Equipment Needs  
From Service Professionals.  
We Buy & Sell Service Monitors.

**Communication Service Monitor  
Repair & Calibration Specialists**



www.nselectronics.com

**NS Electronics Service, Inc.**  
3610 Dekalb Technology Pkwy.  
Suite 110/111  
Atlanta, GA 30340  
Phone: 770-451-3264  
Fax: 770-458-8785



### Cardinal Electronics, Inc.

#### SERVICE MONITOR Repair & Calibration

Exclusive Monitor repair since 1973  
NIST TRACEABLE NEW LOWER RATES  
Visit our Website: [cardinalelec.com](http://cardinalelec.com)

1631 N. Evergreen Ave. Arlington Heights, IL 60004  
Ph. (847) 797-7820 Fax (847) 870-0342

### Loudoun Communications Inc.

*Communications Systems*

#### REPAIR DEPOT

QUALITY SERVICE ON MICROPROCESSOR-BASED  
MOBILES, PORTABLES AND CONTROL HEADS.  
SURFACE MOUNT REPAIR. MOST REPAIRS \$70 PLUS PARTS.  
**FREE ESTIMATES.**

Warranty Service Available On:  
Ericsson/G.E. • Kenwood

585 Factory Shoals Rd.  
Austell, Ga. 30168

770-948-9566

## MEASURE SIGNAL COVERAGE!

- Automate field measurements and drive-tests.
- Create signal contours from measured data.
- Compatible with HP, IFR, Z Technology and other instruments.
- Use your NMEA or TSIP GPS receiver.
- Automatically records signal

**NEW**

**STI-9400 Software**  
**\$4,995.00 Includes**  
**Street Map Data for USA**

**FREE DEMONSTRATION CD**

Toll Free: (877) 848-8500 Fax: (503) 848-8534  
Email: [sales@surveytech.com](mailto:sales@surveytech.com)

**Survey Technologies, Inc.**

*"Geographic Signal Coverage At Your Fingertips"*

[www.surveytech.com](http://www.surveytech.com)

Circle (126) on Fast Fact Card

**mrtmag.com**

**micropath<sup>®</sup> corporation**  
software and terrain data for communications engineering applications

**Radio Propagation Software**

- \* Predicted Area Coverage Maps
- \* Microwave Link Analysis & Profiles
- \* USGS GeoReferenced Topo Maps on CD-ROM

**www.micropath.com**

303.526-5454 Sales  
303.233-4242 Support  
303.233-4026 Fax  
e-mail: [sales@micropath.com](mailto:sales@micropath.com)

## prof. cons. services

### Engineering For The Wireless World

*Wireless Communications Systems and Facilities*

**Define Acquire Build Manage**  
**Design Zone Test Operate**

#### RCC Consultants, Inc.

100 Woodbridge Center Drive, Suite 201  
Woodbridge, NJ 07095

**800-247-4796**

email - [info@rcc.com](mailto:info@rcc.com)

Offices Nationwide & International

Circle (127) on Fast Fact Card



# ad index

Company	Page Number	Fast Fact Number	Advertiser Hotline	Company	Page Number	Fast Fact Number	Advertiser Hotline
AEA, div. of Tempo Research .....	32	26 .....	760-598-8900	Larsen Electronics .....	53	109 .....	800-426-1656
AeroComm, Inc. ....	17	14 .....	201-227-0066	Lindgren R.F. Enclosures, Inc. ....	33	27 .....	630-307-7200
AMI-Applied Micrologic Inc. ....	50	102 .....	817-568-8550	Maha Communications .....	54	111 .....	714-985-9132
Anritsu Company .....	9	8 .....	800-ANRITSU	Mechem Electronics .....	53	110 .....	540-891-0569
Antenex .....	51	104 .....	800-323-3757	Message Center Management .. 14-15	13	.....	860-418-5742
Astron Corp .....	11	10 .....	949-458-7277	MJ Communications .....	55	115 .....	501-945-9307
Barnett Electronics Inc. ....	56	116 .....	800-423-3858	Motorola Test Equipment .....	13	12 .....	800-422-4210
Berkeley Varitronics .....	39	33 .....	732-548-3737	Narda/L3 Communications .....	7	7 .....	516-231-1700
Canamex Communications Corp ...	42	38 .....	800-387-4237	New Hampshire Communications ...	50	100 .....	603-668-3004
Ceotronics Inc. ....	47	46 .....	972-416-9500	New-Tronics .....	43	39 .....	940-325-1386
Citel America, Inc. ....	35	28 .....	305-621-0022	Pagetek, Inc. ....	57	122 .....	919-518-1828
David Clark Co., Inc. ....	24	18 .....	800-900-3734	Paging & Wireless Service Center ...	45	42 .....	800-822-2180
Communications Specialists .....	BC	3 .....	800-854-0547	Polaris Industries .....	55	114 .....	404-872-0722
Computer Resources Inc. ....	58	123 .....	205-987-1523	Polyphaser Corp. ....	12	11 .....	800-325-7170
Connect Systems, Inc. ....	27	20 .....	800-545-1349	Premier Communications .....	31	25 .....	714-257-0300
Control Signal Corp. ....	42	37 .....	800-521-2203	Radio Express, Inc. ....	51	105 .....	703-631-1365
CMC '99 .....	47	47 .....	410-308-0808	RCC Consultants .....	59	127 .....	732-404-2400
CPI Communications Inc. ....	38	32 .....	800-869-9128	RCW Distributing .....	50	101 .....	612-808-0069
CTI Products, Inc. ....	51	106 .....	513-595-5900	RF Imaging & Communications .....	54	113 .....	925-229-2034
Daniels Electronics .....	38	31 .....	800-664-4066	Ritron, Inc. ....	IBC	2 .....	800-USA-1USA
Dapa Communications, Inc. ....	5	6 .....	716-373-7228	Simulcast Solutions .....	54	112 .....	716-223-4927
Davicom Technologies .....	46	44 .....	877-327-4832	Softwright .....	59	125 .....	303-344-5486
DLC .....	45	43 .....	562-404-9998	Southwest Windpower .....	44	41 .....	520-779-9463
Doppler Systems, Inc. ....	40	34 .....	480-488-9755	Survey Technologies, Inc. ....	28	21 .....	503-848-8500
Duracomm Corp. ....	40	35 .....	800-467-6741	Survey Technologies, Inc. ....	59	126 .....	503-848-8500
DX Radio Systems .....	34	30 .....	877-439-7234	Telepath .....	44	40 .....	800-292-1700
EAGLE .....	30	23 .....	520-204-2597	Telewave, Inc. ....	41	36 .....	800-331-3396
EDX Engineering, Inc. ....	22	20 .....	541-345-0019	Thunder Eagle .....	35	29 .....	888-877-8022
E.F. Johnson .....	1	4 .....	800-328-3911	Times Microwave Systems .....	25	19 .....	203-949-8400
EML, Inc. ....	56	118 .....	615-771-2560	Trident Micro Systems .....	18	15 .....	800-798-7881
EPCOM .....	52	108 .....	915-533-5119	TX RX Systems Inc. ....	3	5 .....	716-549-4700
Gaitronics, Inc. ....	37	30 .....	901-947-4000	Vega/Telex Signaling Products .....	10	9 .....	402-467-5321
The Genesis Group .....	58	124 .....	903-561-6673	VERTEX/YAESU USA .....	IFC	1 .....	562-404-2700
Globe Electric .....	56	117 .....	281-933-0909	Vocom Products Co. LLC .....	30	24 .....	847-593-1213
Henry Radio .....	46	45 .....	800-877-7979	WETEC .....	57	120 .....	901-286-6275
International Cellular Telephone ....	50	103 .....	305-640-2424	W & W Manufacturing .....	19	16 .....	800-221-0732
I-Tech .....	23	17 .....	619-458-1500	Zetron, Inc. ....	29	22 .....	425-820-6363
Klein Electronics .....	52	107 .....	760-631-2811				



# YOUR ONE STOP SHOP FOR UHF TRUNKING

Available  
Now!  
Call for  
details.



## The Patriot Plus Series offers LTR and PassPort protocols

Ritron's earned reputation for efficient, versatile, and affordable in-plant radio systems has evolved to give you an edge against obsolescence by featuring backward compatibility, interoperability, and the advantages of trunking. You can now offer your customers affordable in-plant trunking systems and wide area UHF trunking with the new The Patriot Plus Portable radios.



Patriot Plus radios are manufactured in the U.S.A., feature new firmware and high performance electronics, and provide enhanced user features and benefits. LTR and PassPort protocol capable; Electronic Serial Number, and unique radio ID code for automatic roaming between affiliated systems. Narrow and wide band models are available. Updates, enhancements, as well as custom applications, are easily accomplished by use of field reprogrammable FLASH microcontrollers.

Patriot SST Plus Portables are ultra small with flexible features and economically priced. PC Programmable-3/2/1 Watts, 4 channels/modes, Loud and clear audio output, Built-in Quiet Call and DQC signalling.

Patriot RTX Plus Portables are ruggedly designed for long operational life. PC Programmable-4/2 Watts, 11 channels/modes, Designed to meet MIL-STD 810 C&D (shock and vibration) specifications, Companded audio, Loud and clear audio output, Built-in Quiet Call, DQC and optional DTMF Encode Signalling.

Patriot RRX Programmable Repeaters are designed with high performance specifications and loaded with features at an affordable price. RRX Repeaters deliver exceptional intermodulation rejection, sensitivity, and selectivity specifications for trouble-free service. The RRX is also ideal as a trunking exciter.

If maintaining and increasing your market share is important to you... then don't stop. Call us today at 1-800-USA-1-USA and GO with

Patriot Plus by Ritron for all your trunking needs.



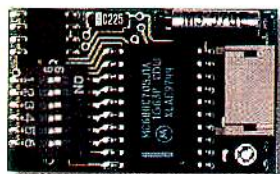
**PATRIOT<sup>®</sup> PLUS**  
BY RITRON

505 West Carmel Drive, Carmel, IN 46032, Phone 317-846-1201, FAX 317-846-4978 [www.ritron.com](http://www.ritron.com)

Circle (2) on Fast Fact Card

Ritron, Patriot, and Quiet Call are registered trademarks of Ritron, Inc. All other product names mentioned are used for identification purposes only and are trademarks of their respective owners.

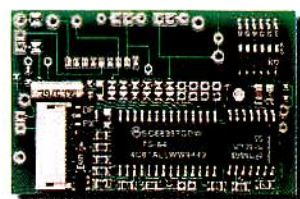




**SS-64** **\$28.95**  
 Microminiature DIP Switch Programmable CTCSS Encoder.  
 Includes 64 tones from 33.0 to 254.1 Hz.  
 .66" x 1.08" x .21"



**TS-64** **\$54.95**  
 Sub-miniature Programmable CTCSS Encoder-Decoder.  
 Includes 64 tones from 33.0 to 254.1 Hz.  
 .78" x 1.70" x .25"



**TS-64DS** **\$57.95**  
 DIP Switch Programmable CTCSS Encoder-Decoder.  
 Includes 64 tones from 33.0 to 254.1 Hz.  
 1.25" x 2.0" x .30"



**ANI-1/\$39.95** **ANI-2/\$299.95**  
 Automatic Number Identification System  
 ANI-1 Encoder - 1.13" x .66" x .22"  
 ANI-2 Station Decoder - 5.4" x 5.8" x 1.4"



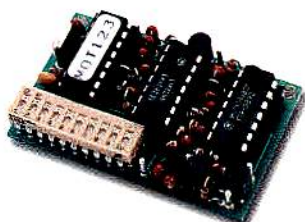
**ID-8** **\$69.95**  
 Automatic Morse Station Identifier. Meets all FCC  
 ID Requirements. Fully field programmable  
 with included keypad. 1.85" x 1.12" x .35"



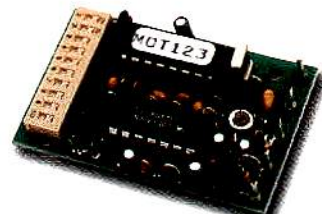
**TP-3200** **\$279.95**  
 Full Featured Shared Repeater Tone Panel with ALL 157  
 CTCSS/DCS codes. In Desktop or Rack Mount versions.



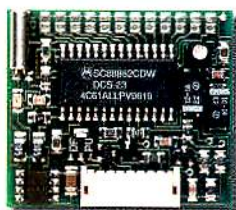
**PE-1000** **\$224.95**  
 Desktop Paging Encoder. Two-Tone Sequential,  
 other formats available. 7.5" x 7.8" x 2.7"



**SD-1000** **\$59.95**  
 Two-Tone Sequential Decoder. Programmable unit  
 provides switched outputs from Two-Tone paging calls.  
 1.25" x 2.0" x .4"



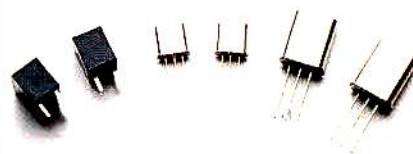
**PE-2P** **\$54.95**  
 Two-Tone Sequential Encoder. Sub-assembly mounts  
 inside radio or other enclosure. Multiple call capability.  
 1.25" x 2.0" x .4"



**DCS-23** **\$59.95**  
 Digital Coded Squelch Encoder-Decoder. Programmable  
 to all 106 DCS codes. 1.36" x 1.18" x .25"



**TE-64D** **\$129.90**  
 Multi-Purpose CTCSS/Burst Tone Encoder w/LED Display.  
 Great for the Benchtop. 5.25" x 3.3" x 1.7"



**FILTERS**  
 Call us for the lowest cost, 12.5kHz channel spacing,  
 exact replacement, crystal and ceramic IF filters for  
 Part 90 Refarming.

- Same reliable and cost effective products you have known and trusted for 30 years!
- Full FIVE YEAR WARRANTY on all products
- "INFO FAX" with 24 hour information
- Same day shipping on most orders
- Toll free 800 numbers for both voice and FAX



**COMMUNICATIONS SPECIALISTS, INC.**

426 WEST TAFT AVENUE • ORANGE, CA 92665-4296

(714) 998-3021 • FAX (714) 974-3420

ENTIRE U.S.A. (800) 854-0547 • FAX (800) 850-0547



Outside USA or Canada: Jessup International, 50, 17th Avenue, San Rafael, CA 94902 USA • Phone (650) 574-1421 • FAX (650) 574-5297

See our complete  
 catalog and product  
 descriptions on our  
 web site at  
**www.com-spec.com**

Circle (3) on Fast Fact Card